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W.P. (CEIP)

# PLANNING FOR THE IMPACTS OF GUAM ENERGY FACILITY EXPANSION

## A PRELIMINARY ASSESSMENT

Guam. ~~Bureau of Planning~~. Coastal Management Program.


COASTAL MANAGEMENT PROGRAM
BUREAU OF PLANNING
GOVERNMENT OF GUAM
AGANA, GUAM



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Guam. Coastal Management Program W.P. (CEIP)

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## A. The Program

The Coastal Energy Impact Program was created by amendments to the Coastal Zone Management Act (CZMA) of 1972 and signed into law July 26, 1976. The purpose of the CEIP program is to "provide grants and credit assistance to Coastal States and communities to help them deal with the impacts of coastal energy development." (FR 43-37, 2/23/76)

Guam, by virtue of having an active program under the CZMA, qualified as a recipient for funding under Section 308(C) of the Act for the purpose of <u>Planning for the Consequences of Energy Facilities</u>.

> Such grants shall be used for the study of, and planning for any economic, social, or environmental consequence which has occurred, is occurring, or is likely to occur as a result of the siting, construction, expansion or operation of such new or expanded energy facilities. (Sec. 308(C) CZMA)

## B. Guam Program Objectives

1) Examine selected impacts of energy facilities upon the community;
2) Determine immediate and in-place plans for expansion of existing energy facilities and the probable impacts of such expansion;
3) Discuss, as far as possible, projected plans for expected development of new energy facilities and the probable impacts of such expansion;

4) Develop method for evaluation of major impacts from new or expanded energy facilities;

5) Generally discuss the pertinent sections of the regulatory process relative to the expansion and impacts of existing and development of new energy facilities; and

6) Recommend strategies available under CEIP for obtaining further federal funding.

C. Methodology

Evaluation of energy facility expansion was based on a range of "decision making" factors. Information available indicates that expansion of energy related facilities will occur in the near future.

These include electrical generating unit(s), the size of which will depend on load projection estimates, expansion of refinery capacity for production and storage, the establishment of a larger petroleum reserve capacity for the island, significant upgrading of transmission lines, and retirement of the remaining 11.5 MW units at the Piti steam power plant and the power barge "Inductance." Other aspects of energy development are not as certain. For example, the development of an extensive Central Terminal Station facility (CTS) has been proposed as has the development of an "alternative" power production method utilizing Ocean Thermal Energy Conversion (OTEC) principles rather than oil fired steam plants. Enlargement of off-loading, and storage facilities for the GORCO refinery as well as Mobil and Esso facilities are possible, but not certain as to timing.

Discussions with individuals involved with the development as well as assessment of resultant impacts provide the foundation for this study, while review of numerous scientific, economic, and social documents provide the depth.

Such a wide range of considerations preclude an exhaustive examination of any individual project, however, sufficient detail is provided to construct policy decisions regarding the advisability or inadvisability of further investigation of a given course of action.

In addition to impacts of energy facility development, the regulatory framework relative to Guam's resources is discussed. The thrust of present energy development must result in an acceptable resolution of seemingly conflicting national and local goals: economic growth for maintenance of an acceptable living standard; conservation of scarce natural resources for future generations; reduced dependance upon foreign petroleum resources, and environmental protection, particularly of coastal waters.

## D. Scope

Three statements of local and national policy set the limits to this study:

> Agencies should "include in the decision-making process appropriate and careful consideration of all environmental effects of proposed actions... (and to) avoid or minimize adverse effects of proposed actions and restore or enhance environmental quality as much as possible...."
>
> Fed. Reg. Vol 40 #72 @16815
> Section 6.100 re
> National Environmental Policy
> Act of 1969

"It is... the public policy of Guam... that a high quality environment be maintained at all times... and that environmental degradation of land, water, and air... should not be allowed."

P.L. 11-91
GEPA Enabling Legislation

"The national objective of attaining a greater degree of energy self-sufficiency would be advanced by providing Federal financial assistance to meet state and local needs resulting from new or expanded energy activity in or on the coastal zone."

CZMA Amendments of 1976
P.L. 94-370
Section 302(i)
Congressional Findings

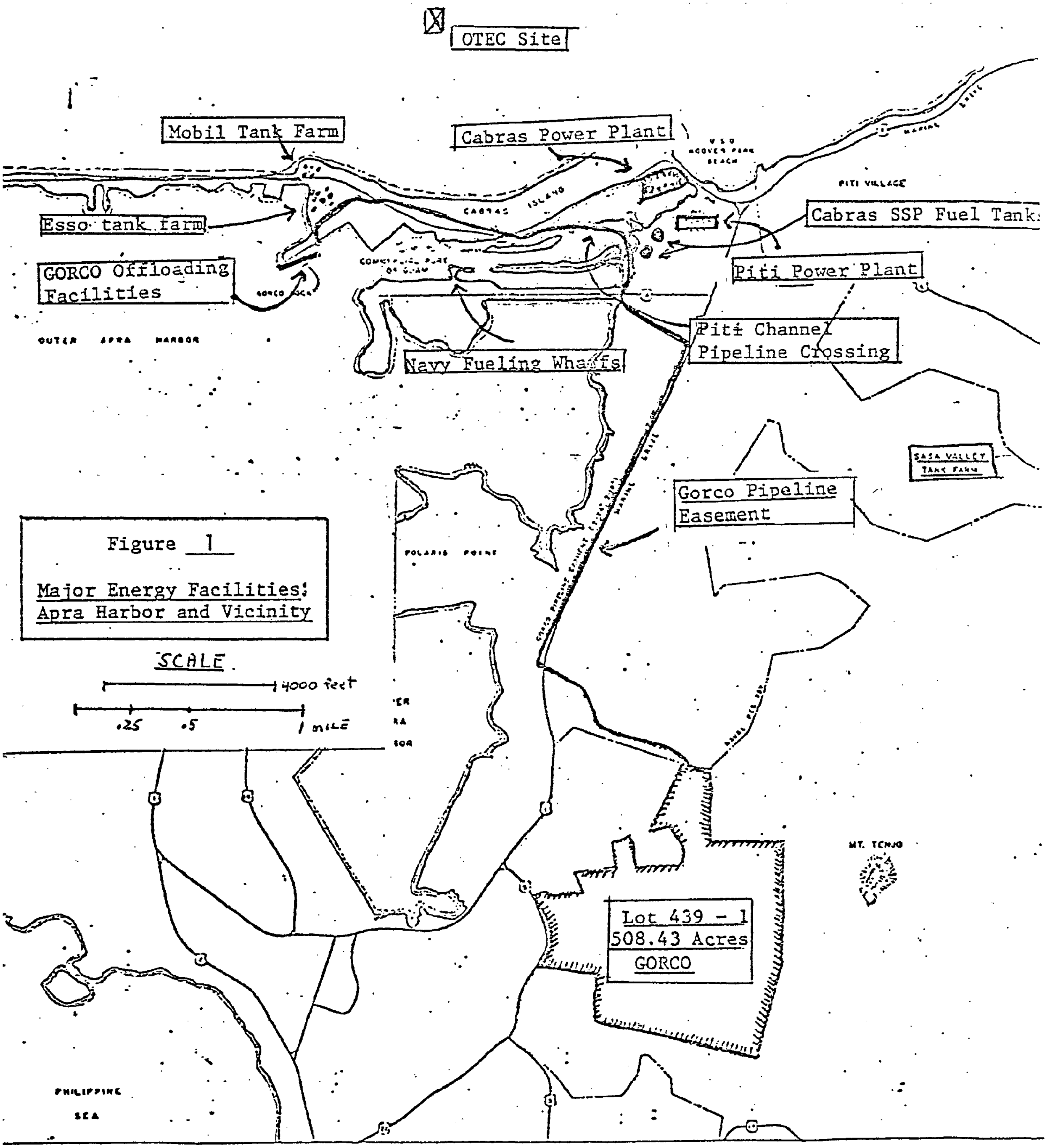
Guam is faced with an especially difficult resolution of apparent conflict between those policies calling for a minimization of adverse environmental impacts and those recognizing the need to expand energy facilities. Many persons feel that national policy and resultant local policy has been set without special consideration being given to the many attributes which set Guam apart from the 'average' locality for which regulations were developed.

Others think that extenuating circumstances are not sufficient to warrant special consideration, and which, in the long-run, theoretically pay for themselves. It is not an impossible task to arrive at solutions satisfying the major part of the range of policy directives.

The need for electric power, however generated, is not going to disappear. It will increase and will be more expensive as new technologies are developed and older technologies are required to adhere to "accepted" environmental standards.

This study examines the need for major energy facility and development, the means for achieving those needs and the factors necessary for arriving at a selection of alternatives providing the best mix of solutions to meet environmental, economic and social considerations.

This study is concerned only with major facility expansion. For example, the various diesel power plants smaller than 5 MW are not considered to have significant negative impacts and are not addressed except for inclusion in calculating system expansion. Generally, the diesels are small, uneconomical, high maintenance, and used only in times of forced outages.



OTEC Site
Mobil Tank Farm
Cabras Power Plant
Esso tank farm
Cabras SSP Fuel Tanks
GORCO Offloading Facilities
Piti Power Plant
Piti Channel Pipeline Crossing
Navy Fueling Wharfs
Gorco Pipeline Easement
Figure 1
Major Energy Facilities: Apra Harbor and Vicinity
SCALE
4000 feet
.25
.5
1 mile
Lot 439 - 1
508.43 Acres
GORCO
OUTER APRA HARBOR
PITI VILLAGE
POLARIS POINT
MT. TENJO
PHILIPPINE SEA

# II. Existing Systems and Future Developments

## II. Existing Systems and Future Developments

### A. Production Facilities

The greatest impact of energy facilities on Guam to date has been from generating units. The newest additions to the Guam power system were the two 66 MW Cabras units which do not meet the definition of new or expanded facilities according to the July 26, 1976 date established CEIP rule and regulations.

#### 1. Existing Plant Capability

Progressions developed in the Bureau of Planning's 1976-1977 report Future Power Production and Transmission Alternatives, (Pinckert-1977) provided estimates for the optimized capability of new plants to meet future demand. For the purposes of this study, more exact definition of assumptions was prepared with cooperation from the Guam Power Authority. The capacity of existing plant was stated as "available for normal operations" rather than nameplate capacity to accurately reflect capability of the system to meet demand. Several Navy diesel units previously not indicated were included as available for emergency purposes even though their reliability is questionable.

Table 1 : Existing Generation Capability

( 1 MW = 1 Megawatt = 1000 Kilowatts )

| UNIT | NAMEPLATE CAPACITY | AVAILABLE FOR NORMAL OPERATION |
|---|---|---|
| Cabras SSP<br>2x66MW* units | 132 MW | 132 MW |
| Tanguisson SSP<br>2x26.5MW units | 53.0 MW | 50.5 MW |
| Piti SSP<br>2x22MW units<br>2x11.5MW units | 67.0 MW | 44 MW |
| Inductance Power Barge<br>1x28MW Steam Unit | 28 MW | 25 MW |
| Tamuning Diesels<br>4x2.0MW units | 8 MW | 6 MW |
| Dededo Diesels<br>4x2.0MW units | 8 MW | 6 MW |
| Navy Diesels | N/A | 10 MW |
| | System Total: | 273.5 MW |

A further breakdown of system capability makes allowance for maintenance and forced outages, while current demand has been revised upward from 150 to 160MW to reflect latest demand statistics available.

Table 2: Maintenance Outage Plus Forced Outage, Minus Current Demand Equals Available Power for Future Load Growth

| | | |
|---|---|---|
| System Total | | 273.5 MW |
| Less: Maintenance Outage (Largest Unit) | 66 MW | |
| Less: Forced Outage (Next Largest Unit) | 25 MW | |
| Total Remaining | | 182.5 MW |
| Less: Current Demand | 160 MW | |
| Remainder to Meet Projected Load Growth | | 22.5 MW |

A derived equation will express the relationship between expected increase in demand, current demand, and the time period of that increase. The variable here is the rate of demand increase. Later discussion of actual peak load demand will narrow the range of these growth figures:

$$160\,(1+y)^n - 160 = 22.5 \text{ where}$$

160 = Current Demand
y = rate of demand increase (1%-6%)
n = time period of increase
22.5 = MW currently remaining to meet projected growth

solving for n

$$(1+y)^n = 1.40625$$
$$n\log(1+y) = \log 1.140625$$
$$n = \frac{\log 1.140625}{\log (1+y)}$$

It was assumed that y would not exceed overall population growth; therefore, the range for this annual increase was set between 1%

and 6%, and the equation solved for n. The result is the time at which the 22.5MW available for projected growth will have reached the point (0) where a new plant should go on stream.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (y) Assumed Annual Demand Increase | 6% | 5% | 4.5% | 4% | 3.5% | 3% | 2% | 1.5% | 1% |
| (n) Number of Years When New Plant Should Go On Line | 2.3 | 2.7 | 3.0 | 3.4 | 3.8 | 4.5 | 6.6 | 8 | 13 |

2. Annual Demand Increase - Narrowing the Choice

Demand increase is based on peak demand. GPA maintains complete records of peak demand (See Appendix 2). Unfortunately, both the oil embargo of 1973 - 1974 and the devastating effects of Typhoon Pamela in May of 1976 make estimates of annual peak demand increase difficult.

The embargo, while actually lowering KW demand for several months, had the overall impact of slowing increase in demand for an extended period. This would account for the rather slow growth in 1974 and 1975. Typhoon Pamela, an event which experts predict on the average of one in seven years, devastated large segments of the distribution system as well as causing damage to generation equipment. While Guam can expect continuous and rather steep increases in the cost of fuel oil over the coming years, natural disaster occurances should not be depended on to keep demand growth down. Recent transmission system improvements will improve the system's ability to withstand typhoon damage.

Table 3 : Approximate Peak Demand Fluctuations - 1971 - 1978
Source: GPA

| YEAR | PEAK DEMAND-MW | % INCREASE OR DECREASE FROM PRECEDING YEAR |
|---|---|---|
| 1971 | 123 | |
| 1972 | 131 | 6.6 |
| 1973[1] | 142 | 8.5 |
| 1974 | 145 | 1.8 |
| 1975 | 148 | 1.9 |
| 1976[2] | 142 | (3.7) |
| 1977 | 148 | 4.0 |
| 1978[3] | 155 | 4.7 |
| '71 - '78 | Avg. increase | 3.4% |
| '71 - '78 | Total increase | 26.0% |
| Eliminating Boom and Bust Years | | 3.8% |
| Assumption | | 3.0% |

1. Direct effects of Arab oil embargo appear to have affected KW demand significanlty for nearly three months, and reduced demand growth for much longer.

2. Typhoon Pamela in May, 1976, substantially reduced demand for nearly three months.

3. FY 1978 figures put actual demand at 150 MW, monthly, averages significantly higher than previous years. Although 160 was used in above equation, 155 seems to be a reasonable estimate for FY 1978.

Reserve ratio should remain at approximately the largest plus the next largest unit as insurance against load-shedding, or service interruption during emergencies. (66 + 25 = 91 MW)

With these new assumptions, the capacity of the new plant can be estimated:

$$* \; NPC = 160\ (1+y)^n + RP + RG - EP$$
$$= 160\ (1+y)^n + 36.5 + 91 - 273.5 \text{ where}$$

* NPC = new plant capability (MW)
  160 - existing demand (MW)
  y = % of annual demand increase
  n = time period of increase plus a period of 5 years when an additional plant must be added
  RP = Retired Plant
  RG = Reserve Generation
  EP = Existing Plant

Table 4: Figuring New Plant Capability

| y (in percent) | n (in years) | VALUES SUBSTITUTED | NEW PLANT CAPABILITY |
|---|---|---|---|
| 6 | 2.3+5 | $160(1.07)^{7.3}-146$ | 99MW |
| 5 | 2.7+5 | $160(1.05)^{7.7}-146$ | 87MW |
| 4.5 | 2.7+5 | $160(1.045)^{8}-146$ | 82MW |
| 4 | 3.0+5 | $160(1.04)^{8.4}-146$ | 76MW |
| 3.5 | 3.8+5 | $160(1.035)^{8.8}-146$ | 71MW |
| 3 | 4.5+5 | $160(1.03)^{9.5}-146$ | 66MW |
| 2 | 6.6+5 | $160(1.02)^{11.6}-146$ | 55MW |
| 1.5 | 8.8+5 | $160(1.015)^{13.8}-146$ | 50MW |
| 1 | 13.0+5 | $160(1.01)^{18}-146$ | 45MW |

## 3. Conclusion

New plant capacity of similar size to one of the Cabras units should immediately enter preliminary planning stages.

## 4. Other Factors Considered

While planners and economists do not foresee a boom of 68-73 proportions, the general feeling given in recent months is cautiously optimistic that Guam can expect a general rise in economic activity in the next 3-5 years. While national economists predict longer term strength of the US economy with some immediate problems, expected population growth together with a slowly recovering economy should keep power demand increases in the 2.8 to 3.5% range in the next 3 to 5 years. Recent publication of the Gross Island Product of Guam (Calendar Years 1972-1976), the first such study available, tends to support this conclusion. The GIP, an overall indicator of the production of goods and services on the island is an excellent measuring-stick for the level of Guam's economic activity. Despite a decline from the 1973 and 1975 highs, the 1976 GIP reflects steadily increasing Personal Consumption and Government expenditures, which make up the major demand sectors on the GIP product side. It is unfortunate that the 1977 figures could not be included in the study since the post-typhoon investment sector has improved considerably, as well as the value of Travel and Tourism to offset increasing deficits in the net exports sector of trades and services. Although correlation is questionable, it is interesting to note that overall peak electric demand only declined between FY 1975 and 1976 (Typhoon Pamela), regaining the 1975 level in 1977, and is projected to reach the highest levels to date in 1978.

Population will also continue to increase although at a declining rate. The Bureau of Planning's population estimates, show, conservatively, an approximate doubling of the civilian population by the year 2000, with a military-plus-dependants figure remaining steady at approximately 22,000; the total for 2000 being in the 170,000 range. The 1970 census mid-range projection was considerably higher with growth rate decreasing from a 1970-1975 high of 4.48% to 2.56% in the mid-1900's, with a total population of 240,000 projected for 2000.

As major new generating capacity is added, units in the present system already near or past economic operation should be retired. This comprises some 51MW of generating capacity including Piti units 2 and 3, and the power barge Inductance.

## B. The Distribution System

### 1. Existing System and Present Activities

Like the island generating plant, distribution responsibility is also part of the Navy/GPA power pool agreement. Navy, with only 25% of the system's generating capacity, controls the load-dispatching of power to island customers. GPA is expected to assume this responsibility in the near future.

The distribution system's major elements include 115 KV and 34.5 KV lines connecting the various generating units with 115/34.5 KV substations, transformers, and 13.8 KV lines from which individual facilities (homes, stores, etc.) draw power.

#### Present Activity - Typhoon Restoration

Primary and secondary transmission facilities were severely damaged by Typhoon Pamela. Most activity presently taking place on the lines (poles) is part of the typhoon restoration projects. The main objective of restoration of transmission facilities is to increase resistance and to minimize damage in future natural disasters. Approximately $24 million will be expended in the next 2-3 years specifically for replacing damaged portions of the power and telephone system grids with typhoon-resistant components. This "pole hardening" effort is being coordinated through the Officer in Charge of Construction (OICC) of the US Navy.

Table 5 : <u>Summary of Pole Hardening by Contract Package, Fund Distribution, Party Responsibility and Approximate Cost</u>

| RESPONSIBLE PARTY | NAVY P115 | NAVY P118 | GOVGUAM F-255 | AF (X) | AF (Y) | AF (Z) | (In Millions of $) APPROXIMATE TOTAL COST DT. CONTRACT AWARD |
|---|---|---|---|---|---|---|---|
| Contract Pkg. and Number | | | | | | | |
| J Package (0207) | (X) | (X) | X | X | X | X | $9.991; 9/77 |
| J Package change orders | n/a | n/a | n/a | n/a--- | | | n/a |
| J-2 Package (0280) | (X) | (X) | X | | | | 4.285; 9/78 |
| 115 KV Package (0273) | X | | (X) | | | | 4,984; 6/78 |
| 34.5/13.8 KV Pkg. (0228) | X | | (X) | | | | ±3.000; Est 12/78 |

Note: (X) indicates major responsibility and funding level

X indicates secondary participation and funding level

<u>Total Project Cost:</u>

±$24 million
(includes change orders and other miscellaneous costs)

Summary of Contract Packages - ongoing pole-hardening projects

"J" Package - (Total Cost: $9.991 million)

13.8 KV Lines

GPA Agana Heights substation to Fena pump station
Marine Drive to NSD fuel farm
Piti substation to Naval Hospital
Agana substation to Barrigada
Route 8 to Barrigada booster

34.5 KV Lines

Orote power plant to Piti substation
Marine Drive to Polaris Point
Piti substation to Adelup Point
Adelup Point to Agana substation
Agana substation to Marbo substation
Marbo substation to Andersen and Harmon substations
Marbo substation to Harmon substation

"J-2" Package - (Total Cost: $4.285 million)

13.8 KV Lines

Orote power plant to SRF substation
Jct. Rts 5 and 12 to Bona Springs
Marine Drive to Black oil tank farm
Marine Drive to cold storage substation
Nimitz substation to Adelup reservoir
Route 3 to FAA
Potts Junction to Ritidian Point
Andersen gate to ammo gate

34.5 KV Lines

Orote power plant to cold storage substation
(Cancelled) Marbo substation to Andersen substation

Summary of "115 KV" Package (GovGuam-GPA)
(Total Cost Est.: $2-3 million)

34.5 KV Lines

Tamuning substation to Marine Drive
Barrigada substation to NAS (Rt 10/8 Jct) substation
(Cancelled) Y-Sengsong to Potts Junction
(Cancelled) Apra Heights substation to Inarajan
Apra Heights substation to "'til funds run out"

13.8 KV Lines

Agana substation to Jct. Routes 10 and 4
Route 10 to Barrigada substation
Medical Center of the Marianas to Tamuning substation
Guam Memorial Hospital to Tamuning substation
San Vitores Road to northern half of Marine Drive
Y-Sengsong Road (Jct. at 3 and 2) to Jct. at Route 3

(See Appendix 3, for maps.)

Discussion

The pole-hardening projects are by far the most extensive activity occurring in any sector of the power grid. By definition of "new or expanded coastal energy activity", pole-hardening can be considered an "energy facility whose...replacement, in whole or part, takes place after July 26, 1976." (931.20-FR43-37 at 7753) However, when the definition of "significantly affected" (931.14) is applied, there appears to be little or no additional demand placed on the island's public facilities in terms of natural resources, or overall economic and social sectors.

Since the vast majority of the poles and lines are located on existing rights-of-way, and the action of pole-hardening is essentially the replacement of wood (termite-prone) poles with prestressed concrete, the negative aspect is simply that the existing objectionable blockage of land-to-sea views will be permanent. It is doubtful, in our opinion, if sufficient argument could be put forth that "public access" in a visual sense has, therefore, been additionally impaired. Economic assessment of this impact, in terms of dollar value, would be an interesting but possibly non-productive exercise.

Following initial damage assessment from Pamela, the feasibility of underground line-placement was discussed with the Navy.

Conclusions based on a 10X cost differential and the fact that typhoon funds could not be used for "upgrading" facilities seemed to preclude underground placement unless the Government of Guam could foot the entire bill. A conservative summary for "coastal lines" whose path had unique features worthy of protection would include:

- J package 35.4 KV line from the cold storage substation to Agana substation
- GPA package 115 KV line from the Agana substation to Harmon substation
- GPA package 13.8 KV lines for: MCM, GMH and San Vitores

The Government did not have, at that time nor presently, the funds to even consider such an undertaking.

2. <u>Future Development - GPA Proposed Major Capital Improvements, Transmission</u>

A number of improvements and additions to present distribution facilities have been proposed. As most of these are tentative plans, GPA officials are not able to predict which alternatives will be adopted.

As presented, the list proposes some $45 million for transmission facilities over the next 22 years. Developments up to 1986 are the most important given expiration date of CEIP, and totals approximately $21.5 million.

Lack of Available Studies

This listing was obtained from the Gov Guam Bureau of Planning. The only readily available written verification of such projects appears on "systems" maps in GPA annual reports, and GPA map "Feeder Line GPA-Distribution, Island-wide Power System," dated January 1, 1976. Commenting on the impacts of projects based on such information is speculative at best.

Table 6 : Summary of Proposed Distribution Facilities GPA

| (START) YEAR | FACILITY PROPOSAL | ESTIMATED COST (1978 dollars) |
|---|---|---|
| 1979 | Dededo substation | $ 80,000 |
| | *Dispatcher Control Center | 2,000,000 |
| 1980 | Pipeline (storage-Cabras Plant | 100,000 |
| | **Tumon substation (22.4 MVA) | 280,000 |
| | Apra substation (10/12.5 MVA) | 40,000 |
| | Talofofo substation (10/12.5 MVA) | 46,000 |
| 1981 | 34.5 KV Talofofo-Merizo Line | 500,000 |
| | Merizo substation (10/12.5 MVA) | 650,000 |
| 1982 | *Adelup substation (10/12.5 MVA) | 650,000 |
| | *Pagat substation (10/12.5 MVA) | 650,000 |
| 1983 | 34.5 KV Pagat-Marbo Line | 300,000 |
| | *Agat substation (80 MVA) | 2,500,000 |
| 1984 | *115 KV Agat-Apra Jct Loop Lines | 2,500,000 |
| | *Talofofo substation (50MVA) | 2,000,000 |
| 1985 | *115 KV Apra Jct-Talofofo Lines | 3,000,000 |
| 1986 | *Chalan Pago substation | 700,000 |
| | *34.5/13.8 Chalan Pago/Barrigada Lines | 1,500,000 |
| | *Yigo substation (112 MVA) | 4,000,000 |

Source: GPA

Notes: MVA = MegaVolt Amperes = 1000 (KVA or KiloVolt Amperes)
* = Total cost distributed over 2 or more years; indicated year shows start of project
** = Includes cost of temporary facility

## C. The Refinery

The GORCO refinery is located on an irregularly shaped piece of land of 508.43 acres in Agat.

Rated at 29,500 bbl/day until 1977, recent completion of the JP-5 (commercial jet fuel) unit raised the capacity of the refinery to approximately 35,000 bbl/day.

Table 7 : Summary of GORCO Refinery Production Capacity-Approximate

| PRODUCT | CAPACITY (bbl/day) |
|---|---|
| LPG | 700 |
| JP-4 | 12,000 |
| JP-5 | 5,000 |
| Diesel | 6,000 |
| Residual | 12,000 |
| Asphalt | 250 |

Source: GORCO

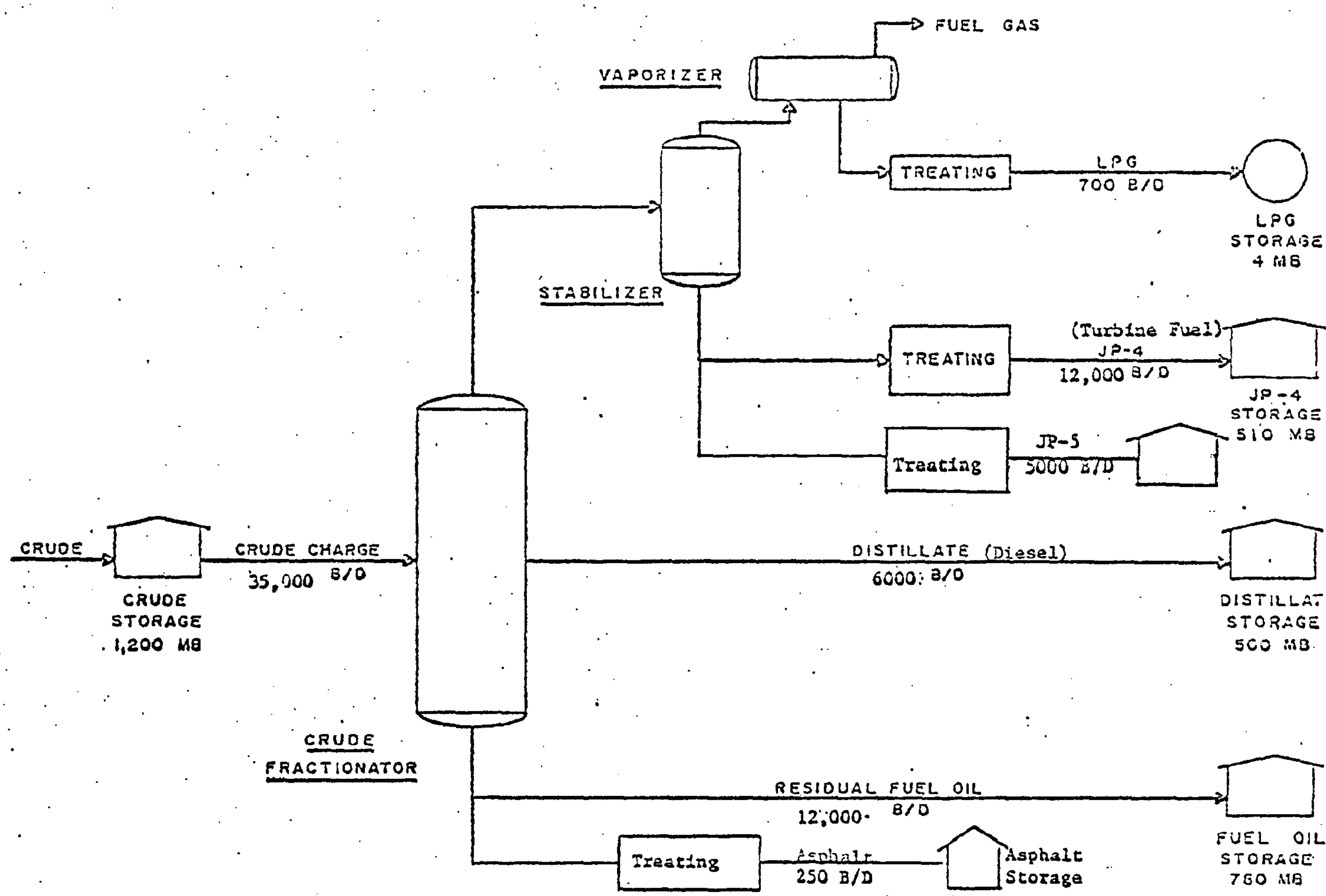
The crude fractioner is the refinery's basic unit. Crude is heated and then passed through the fractioner where it reaches boiling temperature. At various temperatures and pressures, lighter products are drawn off (LPG, distillates), the residual and asphalt being drawn out the bottom. After passing through several treatment processes, the final products are piped to respective storage facilities. The existing plant does not have a cracking unit and does not produce gasoline.

No firm details were available on specific expansion plans. Officials did mention that the Small Business Administration raised the ceiling on the definition of "small refiner" to 50,000 bbl/day from 30,000 bbl/day; therefore, it could be expected that GORCO will continue to expand to 40,000 bbl/day, in the near future, and eventually to 50,000 bbl/day.

Figure 2: GUAM OIL AND REFINING COMPANY, INC.

BLOCK FLOW DIAGRAM

Source: GORCO



Present demands on public facilities are small, although GORCO is the private sector's largest power user. Citing water availability as a major constraint to expansion, the general manager was uncertain as to how the problem will be solved. One well is presently in operation on the premises from which water is treated, used in the refining process, cleaned and aerated, then flows into the Navy sewer system. One 24" Navy-owned water main provides water for the fire-protection grid. Although the Public Utility Agency of Guam (under cooperative use agreement with the Navy) receives payment from GORCO for piped water used, the line itself is Navy property, as is the source of the water, Fena Reservoir.

Discussions with Navy officials indicated that they eventually see an end to this cooperative agreement and that "PUAG should meet the civilian community's water needs" and not the Navy. Some 2.5 million gallons per day are sold to PUAG by the Navy. The bulk of this is for the Agat-Santa Rita area where the refinery is located. It appeared that the Navy foresees a continuation of a split system whereby Navy will meet its own needs. Officials did not care to elaborate on potential water sources and referred to current studies by Barrett and Associates as perhaps providing answers.

Fire protection at the GORCO refinery is felt to be sufficient on-site although coordination is maintained with GovGuam and military units. Foam or light water capability, as well as the firewater loop and sprinkler systems are GORCO-run. Most employees of the plant have been extensively trained in firefighting methods. The foam unit trailer has a 1,500 gpm rating and all light product tanks have foam-protection capabilities. Insurance requirements, it was stated, are exceedingly vigorous and no additional burdens on local fire facilities were seen as resulting from expansion plans.

The GORCO facility is extremely well screened from public rights-of-way, and does not impinge upon surrounding land uses. Atmospheric emissions are well within federal EPA and local standards. The general manager did not foresee any problems with future expansion meeting environmental protection standards, except in the case of wetlands on the property which comprise a high eprcentage of the 20% of GORCO property considered "undevelopable".

## D. Bulk Storage

A large percentage of bulk storage tanks are located on federal property. According to military sources, it is not expected that expansion of military bulk storage facilities will place additional demands on Guam's public facilities.

Bulk storage facilities where major expansion might place additional demands on Gov Guam include:

- Esso Eastern Inc. (Cabras Island)
- Mobil Petroleum Co., Inc. (Cabras Island)
- Guam Oil and Refining Co. (Cabras Island and Agat)
- Guam Power Authority (Cabras Island, Tanguisson)
- Guam International Airport Terminal (Tamuning)

1. <u>Esso Eastern Inc. - Existing Facilities</u>

Esso tanks are located on approximately 6 acres of land leased from the Guam Economic Development Authority.

Table 8: <u>Summary of Esso Bulk Tankage</u>

| TANK | CAPACITY GALLONS | CAPACITY BARRELS | PRODUCT |
|---|---|---|---|
| #1 | 1,389,631 | 33,086 | Gasoline MOGAS97 |
| #2 | 1,200,521 | 28,584 | Gasoline 91 Octane Unleaded |
| #3 | 283,872 | 6,759 | LSADO (low sulphur Diesel |
| #4 | 2,131597 | 50,752 | Jet Fuel AA-1 |
| #5 | 2,130,932 | 50,736 | Jet Fuel AA-1 |
| #6 | 406,905 | 9,688 | Gasoline 91 Octane Unleaded |

Source: Esso East.Inc.

Esso does not own or control off-loading facilities but works under cooperative agreement with GORCO. In the event of tanker scheduling conflicts, Esso maintains a secondary agreement for use of Mobil Petroleum Company's facilities adjacent to the Mobil storage tanks.

2. <u>Esso - Future Development</u>

Of the approximately 6 acres being leased from GEDA, 3 are in use, 1 has been subleased to GORCO deballasting facilities, and 2 remain available for future expansion. This appears adequate for the foreseeable future.

Demand for jet fuel is the major component of Esso operations with gasoline a distant second. Alternately known as AA-1, Jet A-1 JP-1, or DPK (dual purpose kerosene), the Esso jet fuel bulk tanks were designed to serve more than existing demand. The TWA pullout from the Pacific area further decreased demand for jet fuel, and allows the present reserve margin to be sufficient for some time.

Recent discussions with CAB indicate that additional airline service for Guam appears to be possible in the near future. Should this occur, according to Esso's General Manager, it is certain that the demand for jet fuel will increase significantly and most probably would mean the construction of an additional 50,000 bbl tank on unused portions of the Esso land-lease from GEDA.

The primary public facility concern if this and other expansion should occur, should be fire protection, as the Government of Guam has no capability for dealing with oil or petroleum product fires. Of secondary concern relative to needed public facilities may be oil spill containment, where again GovGuam has no capability. In both cases, it was evident that the Navy and Coast Guard would be heavily relied upon in the event of a disaster.

No problem was seen by the general manager insofar as meeting land-use and environmental regulations for future facility development. As new facilities probably will be for bulk fuel storage, Federal Spill Prevention Control and Countermeasures (SPCC) as well as GEPA water quality standards can be easily met with present construction standards. Dikes surrounding the tanks are designed at 120% of tank capacity, and should be sufficient to contain a rupture. Recently installed on the volatile fuel tanks (gasoline), the so-called "ultra-float" system provides a floating seal which prevents vapor build-up between the top of the liquid and the tank roof, thereby eliminating a potential fire hazard.

3. Mobil Petroleum Company, Inc.

Mobil's bulk tankage is located on approximately 11 acres of land on Cabras Island, 5 of which are under long-term lease from Guam Economic Development Authority (on harbor side of road), the balance of 6 acres is leased on a 5-year renewable lease from the U. S. Navy.

Table 9: Summary of Mobil Bulk Tankage - Cabras Island

| TANK NUMBER * | CAPACITY GALLONS | BARRELS | PRODUCT |
|---|---|---|---|
| 3 | 756,000 | 18,000 | Auto Diesel Oil |
| 5 | 2,604,000 | 62,000 | Premium Mogas |
| 7 | 1,764,000 | 42,000 | Jet A-1 |
| 8 | 1,314,600 | 31,300 | Not in service |
| 9 | 1,260,000 | 30,000 | Diesel |
| 10 | 1,764,000 | 42,000 | Auto Diesel Oil |
| 11 | 1,344,000 | 32,000 | MP |
| 12 | 630,000 | 15,000 | Indust.Fuel Oil |
| 13 | 126,000 | 3,000 | Slop |
| 14 | 315,000 | 7,500 | Avgas (100/130) |
| 16 | 117,600 | 2,800 | Asphalt SS1 |
| 17 | 315,000 | 7,500 | Asphalt AP-3 |
| 18 | 2,604,000 | 62,000 | Unleaded mogas |
| 19 | 2,604,000 | 62,000 | Jet A-1 |
| 20** | 1,764,000 | 42,000 | MR |

Source: Mobil Petroleum Company, Inc.

* Missing numbers indicate tanks removed from service

** Tank #20 replaced older tanks dismantled after typhoon damage (See Section 4).

Offloading is carried out on the Mobil fueling pier near the tank farm. The pipelines are such that the products can be taken from or distributed to GORCO's and Navy's fuel piers as well as the GORCO refinery. Recently, over $100,000 was spent improving the pier facility; however, no additional requirements were placed on public facilities. Permits were all reviewed and approved by the appropriate authorities.

Mobil also leases and operates the present Guam Airport Authority's tank farm at the air terminal. By agreement, Esso and SOCAL also use the facility. The present arrangement is a lease agreement with Guam Airport Authority subject to renewal in March of 1979.

4. Mobil - Future Development

The Cabras Island terminal will not be undergoing any major development in the next 5-7 years, according to the general manager. Up to 1986, the only new facilities will be replacements for those tanks which have ended their practical service life.

The Marianas Yacht Club will be allowed to continue operations on Mobil land until such time as they are able to find a suitable permanent site. When tank #20 was built, to replace typhoon-damaged tanks, certain waivers were made with adjoining GORCO and Esso facilities, to allow construction near the latter's property lines such that the Yacht Club would not be disturbed.

Mobil does not see any great change in leasing and development policies until the final decision is made about relocation of the present ammo wharf at Hotel Wharf, as all the Mobil facilities are within the existing blast zone.

Mobil's present facility at the airport will be dismantled at the time that the GAA-owned and Lockheed-run facility comes on line. Mobil and Esso will simply provide the fuel to the Airport Authority.

The general manager did not foresee any significant additional demands on public facilities as a result of Mobil activities. This could be somewhat qualified by discussion of Government of Guam responsibilities, if and when the ammo wharf is moved. It was felt that present fire protection and oil-spill contingency plans are more than adequate, given the exemplary manner in which present operations by all petroleum importers are carried out.

Again, it was stated that Mobil facilities meet all federal standards and that no problem is seen with meeting land-use and environmental requirements in tank placement or pier maintenance activities.

5. GPA - Existing Facilities

GPA's major bulk storage facilities are located near the eastern end of Cabras Island. Two major tanks are located on land acquired from the Navy; the land has ample room for two additional tanks of the same size. Two day-storage tanks located on the Cabras Power Plant site were originally designed for Residual Fuel Oil #6 for burning in the Cabras boilers.

Upon completion of the two large storage tanks which can feed the boilers of both the Navy Piti plant and the Cabras plant directly, one of the day-storage tanks is used for the storage of low-sulphur fuel in the event of an "emergency episode". This "episodic contingency plan" was initiated as an interim measure to satisfy EPA air-pollution, State Implementation Plan (SIP).

Table 10: Summary of GPA Bulk Tankage

| TANK | CAPACITY GALLONS | BARRELS | PRODUCT |
|---|---|---|---|
| #1 Cabras | 420,000 | 10,000 | #6 Residual Fuel Oil |
| #2 Cabras | 920,000 | 10,000 | Low Sulphur |
| #3 Cabras | 11,281,200 | 268,600 | #6 Residual |
| #4 Cabras | 11,281,200 | 268,600 | #6 Residual |
| #5 Tanguisson | 420,000 | 10,000 | #6 Residual |

## 6. GPA - Future Development

Assuming that no major new generating facilities are developed except at the Cabras Island site, two additional tanks will be needed at the time a 4th Cabras unit goes into operation. This date is uncertain at present, but will unquestionably be post-1986.

Presently, the large storage tanks can be served directly from GORCO's Agat refinery or the GORCO fuel wharf. A pipeline is being considered in the near future which would connect the large storage tanks directly to the Cabras boilers. An additional one or two tanks of the 10-20,000 bbl. size are being considered for on-site storage of low-sulphur fuel.

New equipment including both pipelines and heaters may be required if any of the generation units are required to burn low sulphur fuel, or if the price of low sulphur fuel becomes competitive with the price of mid-eastern crude.

### 7. GORCO - Existing Bulk Storage and Pipeline Facilities

Crude and product storage occupies the major part of the developed portion of Guam Oil and Refining Company's Agat complex. (See Table 11 : GORCO Crude and Product Bulk Storage Facilities, which follows.)

GORCO owns and maintains its own offloading facilities on approximately 3 acres of GEDA-leased land to the commercial port. The fuel pier offloads 10-15 tankers in the 40-80 thousand gross ton class, comprising 70-80% of the port tanker's traffic. Esso maintains a joint use agreement with GORCO for the use of offloading facilities. GORCO is presently leasing the two large GPA storage tanks.

#### Pipelines

Although both Mobil and Esso facilities can be serviced from the GORCO pipeline network, the main lines consist of two 24" and two 16" pipes which connect the fuel pier to the Agat refinery via the Piti channels, and Marine Drive easements. (See Figure 2 .)

It is these lines which prevent development of the inner Piti channels for a keelboat harbor-of-refuge or marina use, since at low tide only craft of shallow draft can safely pass over

Table 11: GORCO Crude and Product Bulk Storage Facilities

| TANK NUMBER | PRODUCT | CAPACITY GALLONS | CAPACITY BARRELS |
|---|---|---|---|
| 12-1901 | Crude | 18,900,000 | 450,000 |
| 1902 | Crude | 18,900,000 | 450,000 |
| 1903 | Crude | 12,600,000 | 300,000 |
| 1904 | Diesel/Marine | 12,600,000 | 300,000 |
| 1905 | JP-4 | 8,400,000 | 200,000 |
| 1906 | JP-4 | 8,400,000 | 200,000 |
| 1907 | JP-4 | 8,400,000 | 200,000 |
| 1908 | JP-4 | 2,310,000 | 55,000 |
| 1909 | JP-4 | 2,310,000 | 55,000 |
| 1910 | Residual Fuel Oil | 1,680,000 | 40,000 |
| 1911 | Residual Fuel Oil | 1,680,000 | 40,000 |
| 1913 | Crude/Turbine/Slop | 840,000 | 20,000 |
| 1916 | Distillate | 42,000 | 1,000 |
| 1919 | Navy Distillate | 2,310 | 55 |
| 1922 | JP-5 | 12,600,000 | 300,000 |
| 1923 | Crude | 12,600,000 | 300,000 |
| 1924 | Jet A-1 | 2,100,000 | 50,000 |
| 1925 | JP-5 | 2,100,000 | 50,000 |
| 1926 | LPG | 210,000 | 5,000 |
| 12-1204 A | LPG | 21,000 | 500 |
| 1204 B | LPG | 21,000 | 500 |
| 1204 C | LPG | 21,000 | 500 |
| 1927 | DFM | 840,000 | 20,000 |
| 1928 | JP-5 | 1,260,000 | 30,000 |
| 1929 | DFM | 420,000 | 10,000 |
| 1930 | JP-5/DFM | 420,000 | 10,000 |
| 1931 | Naphtha | 840,000 | 20,000 |
| 1917 | Water | 840,000 | 20,000 |
| Approximate Total Tankage: 3,127,500 bbl. | | | |
| UNDER CONSTRUCTION | | | |
| 1932 | Crude | 21,000,000 | 500,000 |
| 1933 | Crude | 21,000,000 | 500,000 |

the crossing. At the time of construction, pipes adhered to all permit requirements according to the general manager.

Table 12: Product Flow - Major GORCO Pipelines

| LINE | PRODUCT | APPROXIMATE FLOW RATE* (BBL/HR) | ROUTE |
|---|---|---|---|
| 1. 24" | Crude | 3-12,000 | Cabras-Refnry |
| 2. 24" | RFO #6 | 7-12,000 | Refnry-Cabras |
| 3. 16" | JP-4 | 5,000 | Refnry-NFD |
| 4. 16" | Multi-Product | Varies | All Points |

* Pumping rate depends on capacity of ship's pumps

8. Expansion - Bulk Storage, Pipelines, Deballasting

Bulk Storage

No specific plans for major new expansion of GORCO bulk storage facilities are available at the present time. Two 500,000 bbl. storage tanks have received the necessary permits and construction is underway.

GEPA records show GORCO permit applications for nine 500,000 barrel tanks dated 5/30/75. GORCO officials indicated this development was considered as a result of projected retirement of aging storage facilities on foreign soil including Japan and the Philippines. The project is still considered viable and may be revived in the next few years, although the number of tanks may be reduced to six or less.

Approximately 20% of GORCO's land is considered unusable due to wetlands and steep slopes. Officials indicated that expansion most probably will be within the approximately 500 acres of GORCO land holdings.

It is fairly certain that additional product tankage will be increasing as refinery operations expand from the present 35,000 BPD capacity to 50,000 BPD in the not-distant future. Specific plans are not available as to the nature of product tankage expansion.

Pipelines

No specific plans are available for expansion of pipelines. GORCO officials, aware of impending EPA air-quality standards, are in discussion stages of a low-sulphur pipeline from the refinery to Cabras. Additionally, there is a possibility of a pipeline from Commercial Port to the proposed GIAT storage facilities. Planning for these developments is in preliminary stages.

The two 24" and 16" lines crossing the Piti channels will probably have to be moved in the future, according to GORCO officials. It is uncertain as to who will pay for this rather expensive undertaking, since, as mentioned, construction was in accordance with federal and local requirements in 1969.

Deballasting

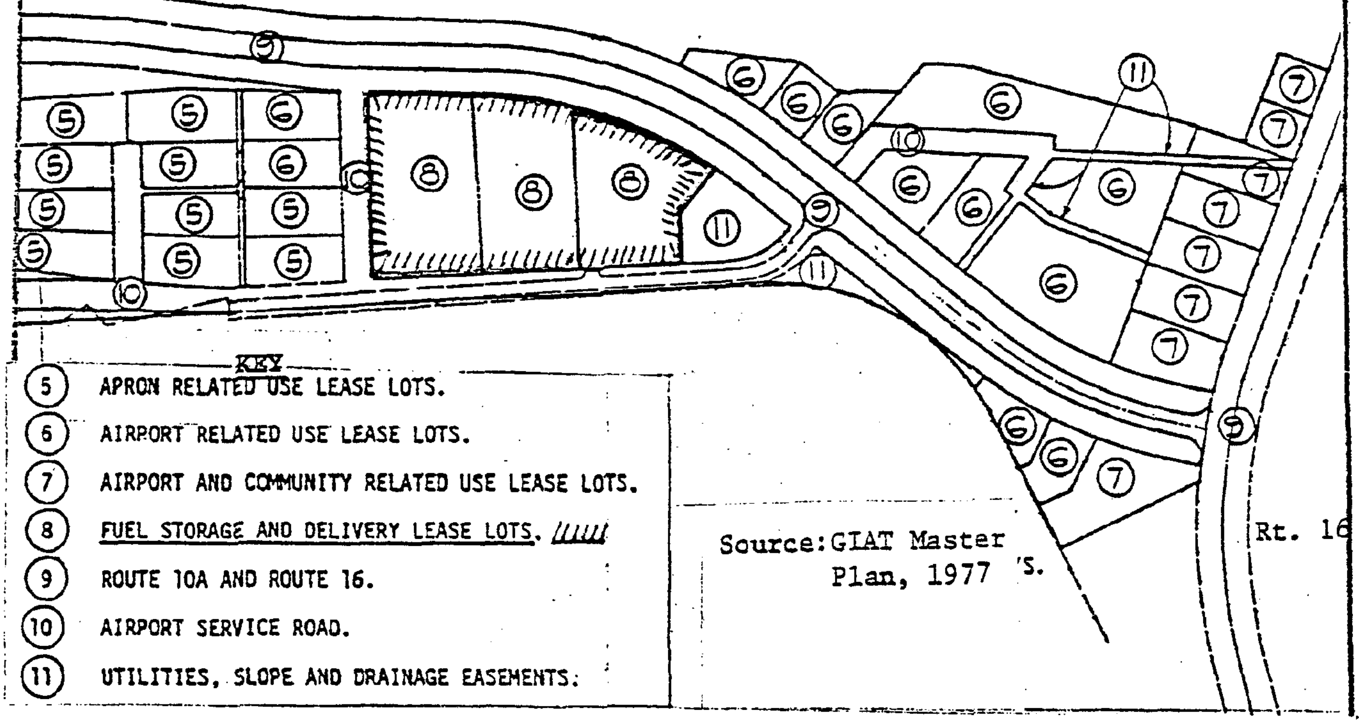
As the refinery's capacity increases, there will be an additional demand for deballasting facilities to accommodate additional tanker traffic. Each tanker arrives with 40-50,000 bbl. of salt water in the holds; this must be processed and discharged "free of oil" or less than 10 parts per million.

Existing deballasting facilities are being upgraded, however, for additional land will be required. GORCO would prefer acquiring Navy land for this purpose, but is also planning for a location adjacent to the large GPA storage tanks. One preliminary plan indicates an impounding basin and setting basin on GPA property behind Tank #1. Area required is about 1.5 times the size of the diked area of one 268,600 bbl. storage tank. A lagoon rather than tank system is envisioned.

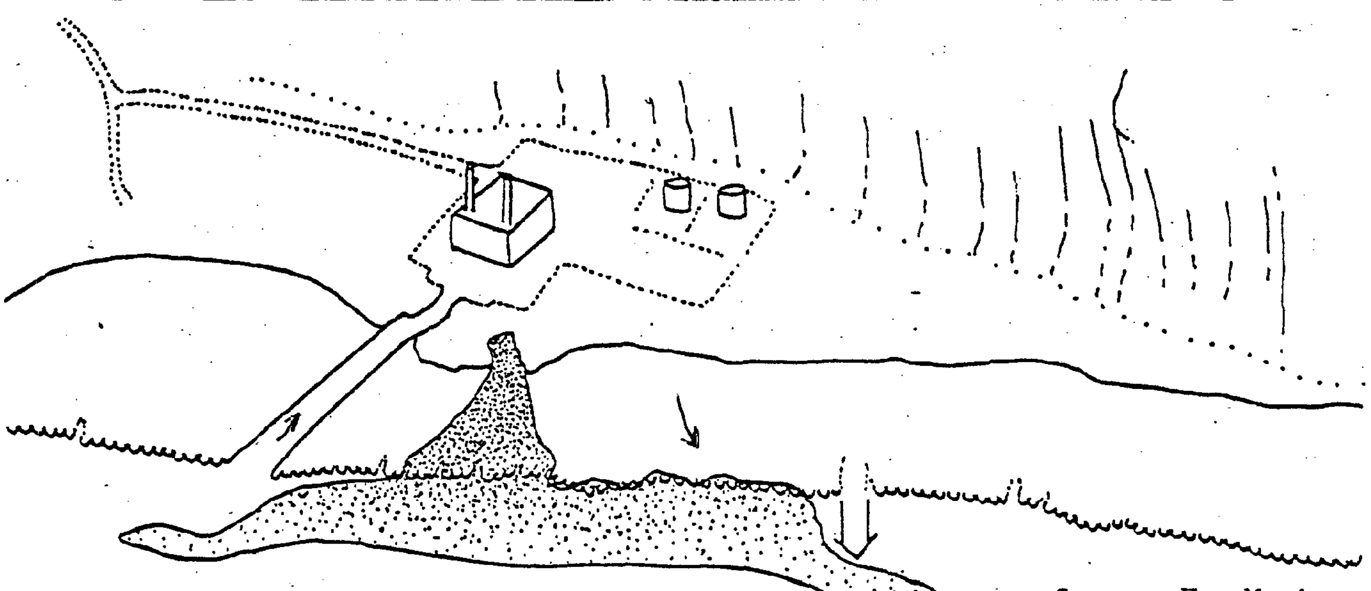
9. <u>GIAT - Guam International Air Terminal, New Tankage</u>

As part or air-terminal improvements, new bulk storage facilities will be located just off Route 16. Existing tankage will be dismantled at the time the Lockheed-supervised project is completed. Tankage for the GIAT-owned site is presently designed for 3 x 10,000 bbl. tanks and one 15,000 bbl. tank. It was the opinion of the Lockheed consultant that facilities including water, fire-protection, and public safety were sufficient as the storage area is a self-contained unit and must meet stringent federal regulations.

Figure 3 : Future Location, GIAT Fuel Storage




Source: GIAT Master Plan, 1977



Source: Uog Marine Laboratory

Figure 4 : Diagrammatic Representation of Tanguisson SPP Thermal Plume

# III. Selected Impacts of Energy Facilities

## III. Selected Impacts of Energy Facilities

### A. Thermal

Studies carried out before, during and after construction and subsequent operation of both the Tanguisson and Cabras steam power plants indicate the specific nature and extent of thermal effluent on two rather different near-shore and relatively shallow marine environments. Results conclusively show that thermal effluent as a result of power plant operations has altered many aspects of the marine environment. The studies' recognition of the importance of biological variability resulted in detailed observations of the "before environment," thereby narrowing the cause of observed changes to power plant operation.

#### 1. Piti Channels

While overall generalizations are sometimes misleading, impact studies of thermal effluent in the Piti channel area seem to indicate that damage is confined to relatively restricted, already greatly-altered areas (Amesbury et al, 1977), and have not been of major significance in terms of a continuous and increasing threat to the overall quality of the marine environment within Apra Harbor.

- Construction activities associated with the building of Cabras Power Plant have probably had a more serious and lasting impact to date than have plant operations. (Marsh, Chernin, Doty, 1977)

- ..the most serious recorded environmental effect... was caused by unnecessary and careless operation of a bulldozer on the Piti Reef (Marsh, Doty, 1975) (Marsh, Gordon, 1974)

- It should also be noted that temperatures on Tidal Flat B exceeded 34°C over a wide area as was the case for Tidal Flat C. These high temperatures likely resulted from solar insolation rather than the influence of power plants. (Marsh, Doty, 1975)

- Power plants impose a more constant temperature on the outfall area than otherwise would occur. This more constant temperature is in the upper part of the natural range... (Marsh, Gordon, 1974)

- Reinforcing 1975 observations - operations of the Cabras Plant were not expanding the areas enclosed within specific isotherms beyond pre-existing conditions, when only the Piti Plant was operating. (Marsh, Doty, 1977)

- Piti channel and Commercial Port areas have greatly altered by dredging, land filling, and construction. (Pinckert, 1978)

Table 13: Effluent and Related Temperature Data - Cabras and Piti SSP

| Plant | Combined Effective Operating Capacity | Approx. Max. Effluent Flow[1] | Delta T (Design)[1] | Actual Mean Temp.[2] | Monthly Average Intake vs Outfall Temperature |
|---|---|---|---|---|---|
| Piti SSP | 44. MW | 64,000 gpm | 5.6°C (10°F) | 30.8°C (87.4°F) | 1.6°C (2.9°F) |
| Cabras SSP | 132. MW | 120,000 gpm | 5.6-8.3°C (10-15°F) | 32.0°C (89.6°F) | 2.8°C (5°F) |

| Inner Channel Tidal Flat Temperatures[3] | Ambient Apra Harbor Temp. Range[4] |
|---|---|
| Flat A<br>29.5-32.5°C<br>(85.1-90.5°F) | 27.2-29.4°C<br>(80.9-84.9°F) |
| Flat B<br>28.5-33.5°C<br>(83.3-92.3°F) | |
| Flat C<br>28-33.6°C<br>(82.4-92.5°F) | |

1. Marsh/Gordon (1974)
2. Marsh/Chernin/Doty (1977)
3. Marsh/Gordon (1973)
4. Emery (1962)

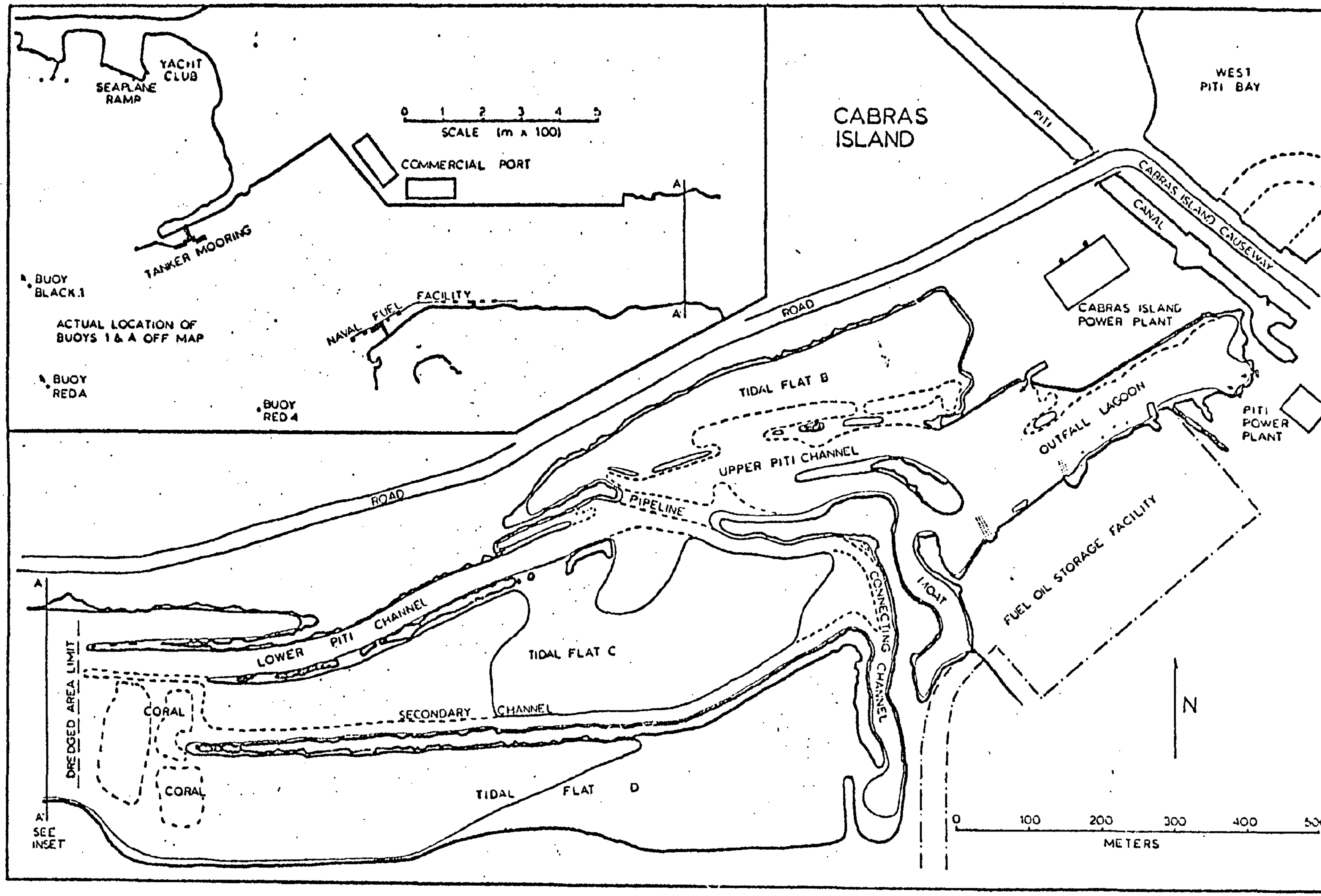



Figure 5: Major features of the area affected by the effluents of the Piti and Cabras Power Plants. Inputs of water from the power plant outfalls are indicated by arrows. Tidal Flat A was filled to provide the construction site for the Cabras Power Plant.

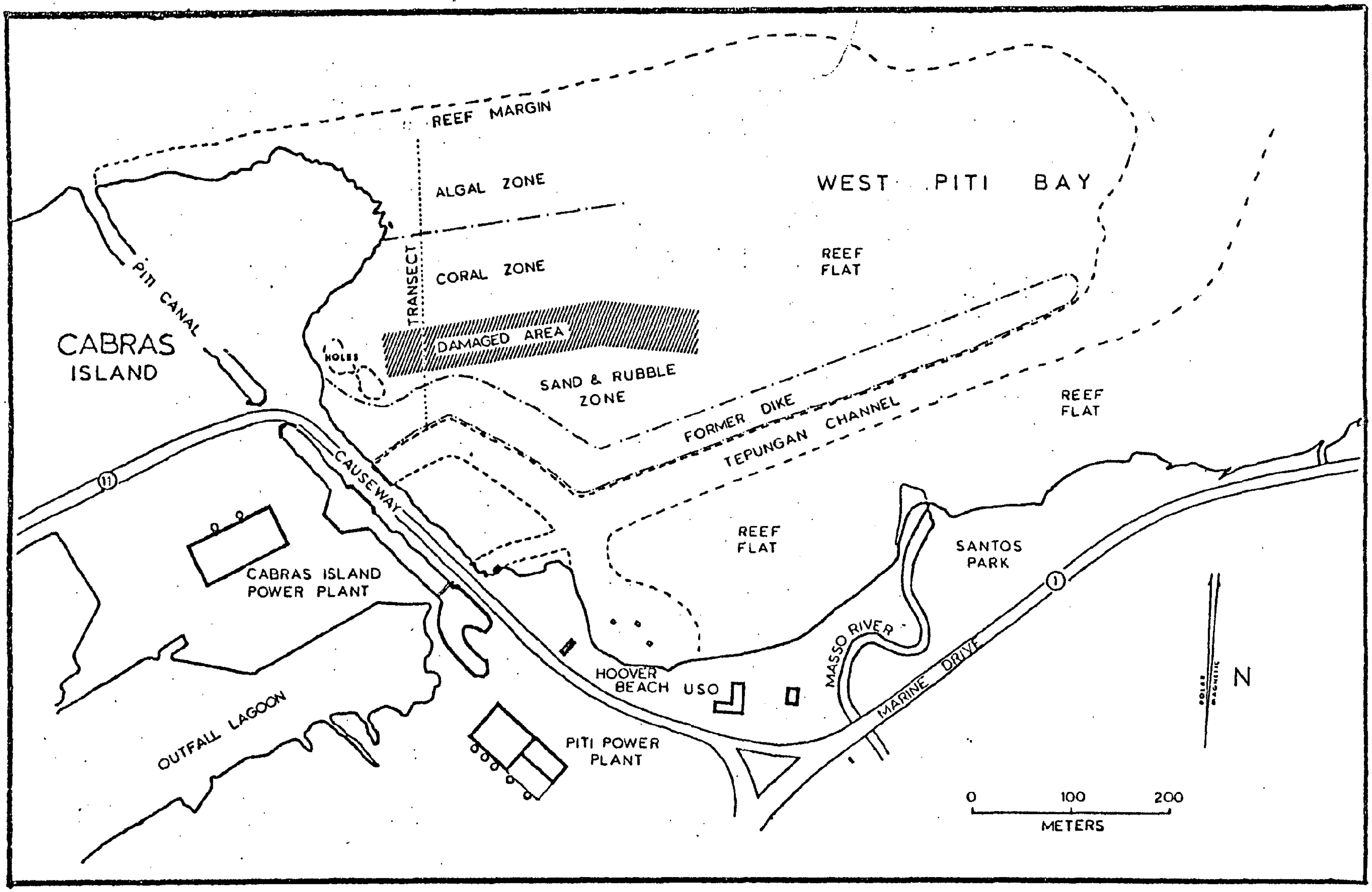



Figure 6 : West Piti Bay showing the major features in the area of the Piti and Cabras Power Plants. The location of the damaged area was determined in conjunction with Guam EPA.

## 2. Cabras Island/Piti Channel Area Summary

The sum total of the data reviewed seems to indicate that while the power plants certainly add a hazard in terms of increased temperature to the Piti Channel area:

- the overall impact is not significantly greater than the impacts of natural solar insolation; and
- the significance of the impacts are further reduced given the extreme alteration of the Piti Channels from past development; and
- expected development to the west of the Piti Channels adjacent to the commercial port will continue to severely alter "natural" conditions of the area.
- despite power plant thermal intrusion, Piti Channels and lagoon frequently used recreational areas for fishing, picnicking, and heavy weather boat anchorage.

Conclusions to the effect that "anything goes" insofar as continued development of energy facilities on Cabras Island should not be inferred here. It should be noted that the causeway built to the island obstructed the natural flow of water through the Tepungan Channel, thereby artificially establishing an area subject to solar insolation to a greater degree. It was probably more coincidence that location of the power plants and their heat plumes took advantage of this situation whereby heated effluent has a less-than-usual impact on the environment. Given this situation together with expected development in the port area, it would seem reasonable to conclude that future energy facilities would not significantly increase the present impacts. However, extreme care should be taken by the developer of future facilities not to exacerbate this marginally acceptable situation.

### 3. The Tanguisson Experience

Located on the north-east coast of Guam, the GPA/Navy Tanguisson power plant has been under observation since operations commenced in October 1971 (unit #1) and December 1972 (unit #2).

Table 14: Tanguisson SSP Data*

| Capacity | Approx. Max. Effluent Flow | Mean Intake Temp. Range | Mean Outfall Temp. Range | Mean Delta T | Max. Reef Flat Temp. Range | Ambient Ocean Temp. Range |
|---|---|---|---|---|---|---|
| 50.5 MW | 35,000 gpm | 26.9-29.5°C (80.4-85.1°F) | 32.5-37.0°C (90.5-98.6°F) | 7°C (12.6°F) | 30-33°C (86.0-91.4°F) | 27.6-29.3°C (81.7-84.7°F) |

*Note: Data from same sources as Table 1.

Unlike the Cabras Island/Piti Channel location, the Tanguisson plant was built directly adjacent to the narrow fringing reef and within a beach strand environment. Thermal effluent has directly affected a significant portion of reef. By coincidence, during the period of June-September 1968 the coral-eating crown-of-thorns starfish (Acanthaster Planci) devastated the area seaward of the reef front zone killing over 95% of reef building corals. Thus, the study could not be based upon actual observed kill, but rather on observed re-growth patterns in effluent-affected vs. non-effluent areas.

The overall conclusion is that the Tanguisson thermal effluent is responsible for the destruction of some 20,000 $m^2$ of the coral reef community. While other factors such as biofouling treatment (since discontinued) played a part in initial biota damages, "There is no doubt that the thermal effluent from the

Tanguisson power plant is responsible for the death of hermatypic (reef-building) corals along the reef margin," (Neudecker, 1976). Not limited to coral impacts, "Fishes that are characteristic of the reef flat (many are territorial species) abandoned the plume area. The same was true for crustaceans and echinoderms." (Jones, et al, 1973).

Generally speaking, upper tolerances for corals is 30° - 33°C. At 4°C above summer ambient temperatures (28.5°C), eighteen species of reef corals died within 6 - 14 days, at 6°C above ambient, in 6 days or less. While corals are resettling in the Acanthaster-devastated areas outside of the temperature plume, "...there is no evidence of coral resettlement in the reef margin area within the influence of the effluent." Neudecker (1976, 1977) specifically investigated the growth of coral transplants in and near Tanguisson effluent, as well as the effect of coral removal on the rest of the community. Conclusions indicate that the obvious is true, "When corals die, many species closely associated with them either die or move to a more favorable area." (Neudecker, 1977). Furthermore, the long term possibility is that "...biogeochemical and physical erosion ... will result on the reef platform opposite the power plant." (Jones, et al, 1973).

The good news is that the area of kill does not appear to be expanding and is directly proportional to the generating capacity of the plant, and unless the generating capacity is increased or additional toxic chemicals are introduced, the kill area should remain stable. (Neudecker, 1976).

## B. Erosion and Sedimentation

Effects of erosion and sedimentation are a constant threat with large scale onshore or nearshore energy facility development, particularly in areas having significant amounts of eroded and weathered volcanic overburden. The best example of such impacts, although not related to energy, was caused by improper and poorly timed site preparation on steep slopes of the Nimitz Hill housing estates. Resultant sedimentation caused a massive coral kill in Agat Bay. Energy-related projects of similar and greater magnitude have been discussed, but no definite plans are available.

Several studies are available addressing the impacts of siltation and sedimentation on the marine environment. The most recent, Sedimentation Studies at Fouha and Ylig Bay, (Randall, Birkland, 1978) was designed to scientifically assess the effects of sediments on reef systems. The natural gradient of coral growth, was compared with the gradients of suspended sedimentation to determine a cause/effect relationship. Once gradient values are established, with further model development, they could be applied to different reef environments to predict sedimentation impacts due to increased input from land and coastal development. The following table is derived from the above study.

Table 15: Summary of Sedimentation Impacts on Coral Species Diversity

| INDICATORS | | EFFECT | | |
|---|---|---|---|---|
| Time | Area | Sediment Load | Number of Species | Substrate Coverage |
| 6 weeks | 4.4 $cm^2$ | 1 - 6 grams ↓ 30 - 40 grams | over 100 ↓ less than 10 | 12 % ↓ 2 % |

Source: (Randall, Birkland, 1978)

In effect this study conclusively supported previous observations that "alteration of coral diversity follows a similar gradient of high to low levels of sedimentation...." (Basline Study, p. 25). To date initial construction has had the greatest impact as far as site and surrounding area impacts. There is no record of continuing siltation or erosion caused by energy facility operation.

B. Atmospheric Emissions

1. General

Guam's major power plants use #6 Residual fuel oil for firing boilers. Resultant emissions include sulfur oxides, carbon oxides, nitrogen oxides, and particulates.

Table 16: Approximate Composition, #6 Residual Fuel Oil As Presently Fired

| | |
|---|---|
| Carbon | 87 - 88 % |
| Hydrogen | 9.5 % |
| Sulfur | 2 - 2.5 % |
| Ash | .01 % |

Note: "Low Sulfur" crude contains only trace sulfur.

The major concern on Guam is sulfur dioxide given its well documented impacts as a pollutant. Unfortunately for Guam, $SO_2$ regulations are based for the most part on major population centers in the continental U.S. where sulfur oxide and other emissions directly and negatively affect people, buildings and biota surrounding the source. Except for infrequent episodes, most $SO_2$ drifts with the prevailing winds over the ocean, falls into the water and is absorbed by natural processes. When prevailing winds direct $SO_2$ emissions toward populated areas, the power plant contingency plan goes into effect based on sampling station readings inland from the Cabras Island Plants. The boilers are switched to low sulfur fuel until the winds switch to a more favorable direction. Under such a system, sulfur oxides have essentially no effect on Guam's environment.

Guam's standards are contained in the Guam Air Quality Implementation Plan which is currently under revision from 1974.

NSPS or New Source Performance Standards apply to the Cabras Plant since construction began after August of 1971. New stacks for the Piti Plant are nearing completion which will exhaust gases at a higher level. Tanguisson seems to be acceptable at present, pending outcome of enforcement discussions.

2. Emission Standards

Pertinent standards include sulfur oxides, particulate matter, and nitrogen oxides.

Table 17: Selective Summary of Guam's Ambient Air Quality Standards

| Indicators | Sulfur Oxides | Particulates | Nitrogen Oxides |
|---|---|---|---|
| Annual Mean | 60mg/$m^3$ (0.02ppm)[2] | 60mg/$m^3$ (0.02ppm) | 100mg/$m^3$ |
| 24 hr. max.[1] | 365 (0.12ppm) | (geometric mean) | NA |
| 1 hr. max[1] | 1300 (0.5ppm) | NA | NA |
| 4 hr. max[1] | 650 (0.25ppm) | (8 hr) - 360mg/m | NA |

Source: GEPA

[1] Permitted once a year
[2] Micrograms per cubic meter
PPM = parts per million

During 1975 - 1977, the ambient level of sulfur oxides (measured in the vicinity of the Cabras and Piti plants) measured 13 micrograms/$m^3$, far below the 60 micrograms/$m^3$ National Standard .

Nitrogen oxide concentrations are well within EPA standards and should remain so if the trend over the past 3 years continues.

Power plant operations do not contribute significantly to the relatively high particulate concentrations seasonably evident on Guam as #6 RFO does not produce significant amounts of fly-ash or particulates. Of greater importance is the coral base of approximately 50% of Guam, and the fact that particulate readings are only taken in the area of intense particulate-producing activities. An extremely heavy concentration of large, fast moving trucks over roads in poor repair on coral-base Cabras Island is probably the main producer of particulates.

Table 18: $SO_2$ Episode Frequency Based on Wind Rose Data

| | Wind Direction (from) | % of time | Wind Direction (from) | % of time |
|---|---|---|---|---|
| | N | 1.4 | S | 2.7 |
| | NNW | 1.2 | SSE | 3.9 |
| $SO_2$ Episode | NW | .7 | SE | 7.9 |
| $SO_2$ Episode | WNW | .7 | ESE | 21.0 |
| $SO_2$ Episode | W | .7 | E | 26.5 |
| $SO_2$ Episode | WSW | .6 | ENE | 19.9 |
| $SO_2$ Episode | SW | .9 | NE | 7.4 |
| $SO_2$ Episode | SSW | 1.7 | NNE | 2.4 |
| Probable $SO_2$ Episode = 6.5% | | | | (US Navy) |

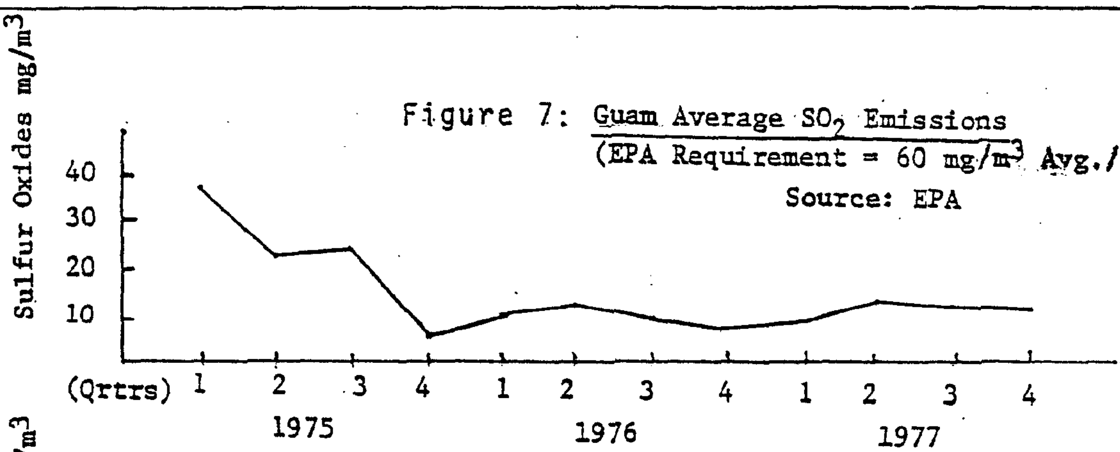



Figure 7: Guam Average $SO_2$ Emissions (EPA Requirement = 60 mg/m$^3$ Avg./yr. Source: EPA

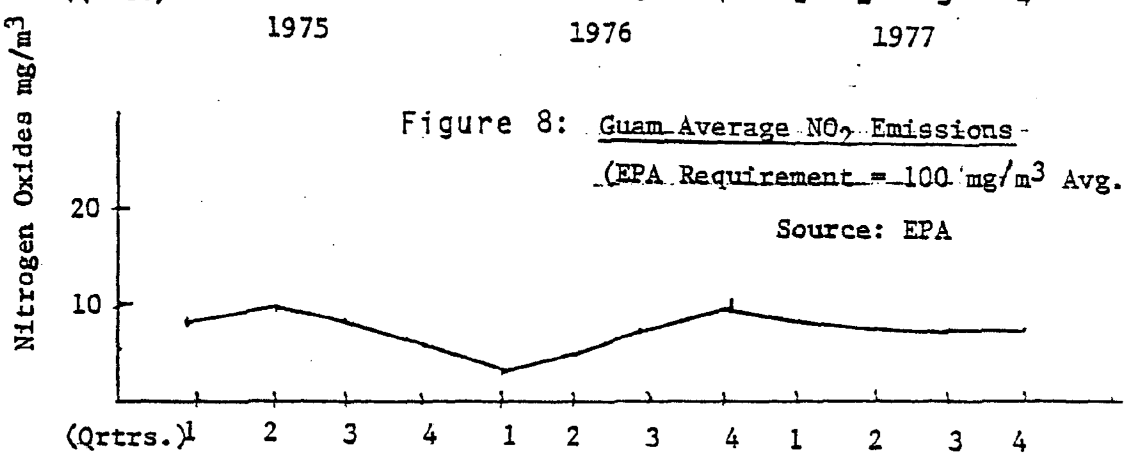



Figure 8: Guam Average $NO_2$ Emissions (EPA Requirement = 100 mg/m$^3$ Avg./yr. Source: EPA

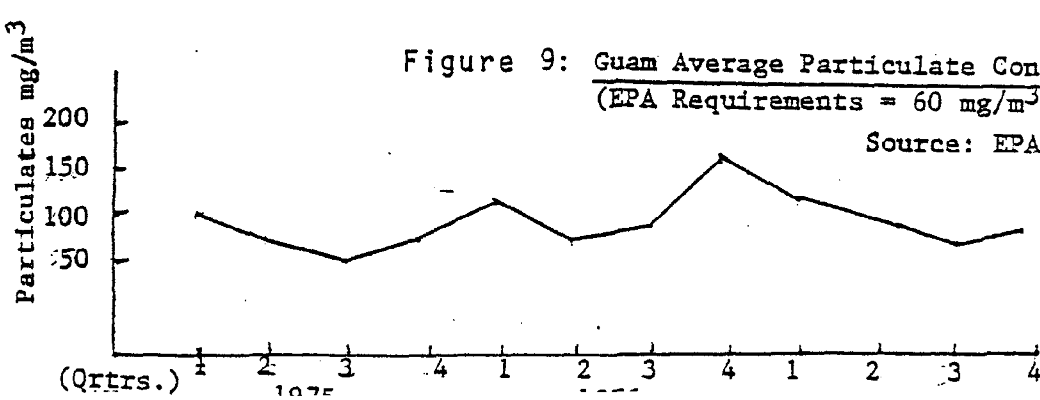



Figure 9: Guam Average Particulate Concentrations (EPA Requirements = 60 mg/m$^3$ Avg./yr.) Source: EPA

## C. Oil Pollution

### 1. Off Loading Operations

Tankers entering Apra are in the 100,000 DWT (dead weight ton) range or below given the anchorage's limited bottom depth, maneuvering room, facilities, and tankage requirements. Most tankers are in the 40-80,000 gross ton category. Approximately 4 ships per week on the long term average off load at GORCO, Mobil and Navy Facilities; 10-15 per month (70-80%) are GORCO/Mobil tankers, the balance being Navy and ESSO. National figures of polluting incidents in and around U.S. waters indicate Guam spills totalled 216 barrels in 1977, too small an amount to contribute to a percentage of the national total. (U.S. Coast Guard, 1978).

Table 19: Latest Summary of Port Oil Transfer Operations

| Period | Barrels |
| --- | --- |
| 1977 4th Quarter | 6.7 million |
| 1978 1st Quarter | 5.13 million |
| 1978 2nd Quarter | 5.6 million |

Source: U.S. Coast Guard

Coast Guard figures show 111 ship transfers and 9 barge transfers (44,000 bbls) took place in the 2nd quarter of 1978. These together with the 100-plus transfer operations in the first quarter of 1978 resulted in 12 very minor spills, most of which were simply sheens.

The Apra Harbor marine environment has not been exposed to impacts of significant oil pollution. Bottom sediments and marine organisms are free of petroleum derived hydrocarbons.

2. Spill Impact

Tropical waters because of relatively constant stresses are more vulnerable to large-scale spills than temperate or arctic marine systems due to the latter's adaptability to change. A recent NOAA National Marine Fisheries Bulletin stated that while it is not possible to predict the environmental impact of a spill, several factors govern the overall impact:

- type of oil spilled
- how much
- physiography of the area
- weather conditions at the time
- biota of the area
- previous exposure of the area to oil
- season
- exposure to other pollutants
- treatment of the spill

A tanker grounding within the harbor would probably be at low speed and would suggest that a maximum accident, the entire cargo being lost, probably would not occur. The physiography of the harbor is such that while several wetlands may be affected, bottom sediments are mostly unconsolidated and not particularly rich with plants, clams, mollusks and other bottom dwellers. However, heavy oils or crude reaching the bottom would remain for an extremely long time, before natural oxidation occurred.

Compared to the richness and diversity of other portions of the fringing reef, Apra Harbor does not have extensive coral growth. Some of this has already been exposed to significant amounts of sedimentation. The fact that the harbor has not been exposed to large amounts of hydrocarbon pollution means that those organisms directly affected would probably be devastated.

Depending on the location of the spill, prevailing winds from easterly directions would encourage suspended pollutants to move in the direction of the harbor mouth. As well as fouling bottoms and shorelines adjacent to and along the drift of a spill, prevailing northerly swells at the harbor mouth may result in additional heavy fouling at Orote Point. Surface movement away from the Sasa and Atantano River wetlands or the eastern end of the harbor would be aided by the "dominant westward outflow of water in the area on both ebb and flood tides." (Marsh et al, 1977).

Estuaries are particularly susceptible to the impacts of oil pollution where the killing of bottom-dwelling plants and animals generally loosens bottom sediments causing both erosion and movement of the pollutant to new areas. Major effects of spills in other locations has been destruction of bottom vegetation, wildlife and birds, fouling of beaches, rocks, harbor facilities, moored boats and the devastation of biologically productive shallow water bottoms. Locally, impacts would not be critical once floating oil left the harbor and sank in the deep waters immediately adjacent to the harbor entrance. The deep ocean bottoms off the coast are not particularly suitable for marine resource exploitation, nor do they appear to play a significant part in the maintenance of the shallower water biota. A port consultant stated that a large spill within the harbor could be more easily contained than in other locations since the inner harbor could be effectively separated from the outer harbor and that water turbulence would be minimal under normal conditions. If an incident could be dealt with in a relatively short period of time, much damage can be completely avoided.

The Coast Guard, the Port Authority, and officials of Mobil, ESSO, GORCO, DPS and Navy feel that extensive discussion of "maximum accident scenarios" such as these are slightly alarmist in nature. Even with substantially increased tanker traffic it was felt that traffic control measures, highly efficient inspection and supervisory operations, the ability of the Coast Guard's contingency plan to deal with a spill situation, and the relative ease of spill containment in Apra Harbor significantly reduces the spectre of an all-out ecological disaster.

### 3. Oil Spill Contingency Plan

The Marine Safety Office (MSO) located at the Commercial Port has recently completed drafting of Guam's Oil Spill Contingency Plan. The MSO, as established by Federal law, has authority vested in the Captain of the Port dealing with:

- fire protection and prevention
- storage control
- entry control
- tug standby
- bi-annual ship inspections
- yacht documentation
- licensing
- charter boating.

The contingency plan itself contains listings of all equipment available through private as well as Federal and local government sources and outlines procedures for notification and mobilization of equipment and manpower in the case of a spill. The Coast Guard emphasized that the cleanup is the responsibility of the pollutor, and Coast Guard participation should not be in actual cleanup operations except under extraordinary circumstances, where the responsible party would be assessed for the costs. The Oil Spill contingency funds can be used for cleanup and prevention purposes pursuant to amendments to the Clean Water Act, effective 28 December 1977. The Coast Guard estimated that in the event of a major spill the national regional strike force established under the Federal Water Pollution Control Act could be operating on Guam within 10 days.

Spill prevention regulations dealing primarily with vessels cover a range of potential pollution sources including hoses, drip pans, ship-to-shore communications, operations manuals, ship transfer operations, investigations of hazardous substances and cargo sampling. No ship is allowed to offload until an inspection is completed. Proof of a valid insurance (FMC) certificate is mandatory.

## D. Dredging and Filling

The best Guam documentation of energy-related dredging and filling activities is contained in Marsh and Gordon's "Marine Environmental Effects of Dredging and Power Plant Construction in Piti Bay and Piti Channel, Guam" (1974). Further study of major dredging/filling impacts has been carried out during construction of the Agana Boat Basin and Sewer Treatment Plant, the Northern District Wastewater Outfall, in small projects including DHL's dock/groin on Cocos Island, and various bridge construction activities.

Review of these studies indicate:

- area of impact is generally limited to the area actually dredged and/or filled;
- turbidity and sediments place a temporary stress on surrounding areas, but not necessarily lethal if, (a) reasonable precautions are taken and (b) natural flushing of the affected area is not interfered with;
- the use of silt screens and (when possible) operation timing to coincide with tidal and climatic conditions can reduce temporary stress significantly.

Other than damage caused by an errant bulldozer, "...the Piti reef flats which were disturbed by dredging in Tepungan Channel have returned more or less to their original state," and "...most of the fine silt deposited on the reef flat has been now swept away, and the substrate appears much as it did before." (Marsh, Gordon, 1974).

It appears that the major caveat to dredging and filling operations is the necessity of the operation, and if necessary, the extent of the operation. As far as energy facilities are concerned, the record is good on both counts in addition to the fact that extensive new dredging and filling operations of the marine environment do not appear imminent. Possible exceptions could be port expansion activities which may include parts of the GORCO docking area, and additional outfall related work which could result from EPA actions requiring effluent control mitigation measures. Sufficient area adjacent to the existing Cabras Units (built on reclaimed land) was provided through the foresight of the project engineer to avoid future dredging and filling activities. Tepungan Channel was also designed to be able to serve additional plant capacity.

Shoreline stabilization and channel maintenance on the Tanguisson plants did not cause long-term impacts outside of the actual construction area.

Should GORCO or other entities decide the location of pipelines crossing the Piti Channels be altered, a dredging will be required, but impacts should not be of major importance given the already greatly altered (man-induced) marine environment.

In conclusion, it appears that required dredging and filling operations directly related to energy facilities have been carried out in a fairly responsible manner, and aside from one major avoidable incident, have not caused impacts greater than expected.

## E. Economic/Social Impacts

The economic and social impacts of availability of a dependable source of electric power has been widespread and penetrating. A drastic change in the short run would be detrimental to the island's lifestyle.

Guam would be more susceptible to increasing costs of energy if it were not for the presence of the GORCO refinery on island. Without such a facility, civilian supply of generating plant fuel (Residual #6) and others would be more at the mercy of international marketplace fluctuations, as well as a good deal higher in price and less certain in availability.

Operation of many projected bases of Guam's economy (tourism, light manufacturing) are energy dependent with the possible exception of agriculture. Lifestyle, particularly in the area of housing and related domestic amenities, is increasing its dependence on electric consumption. Block concrete houses with little emphasis on good insulation, natural ventilation, and increasing reliance on total and constant air conditioning will hasten spending of larger proportions of disposable income on energy.

It is true that a vigorous conservation program would slow the demand for power, and thereby postpone the need for future production facilities. This will call for programs stronger than public information. Even if recently passed National Energy Legislation does not provide adequate incentive for persons to conserve power and fuel consumption, the rising prices brought about by deregulation of petroleum product prices may force a change in attitudes. It is hoped by economists that price deregulation will make alternative energy sources more competitive with petroleum.

How does all this affect Guam? Guam imports all of its petroleum, most of which comes from the Persian Gulf. Projected energy facility expansion will continue to be based on petroleum unless a significantly increased effort on the part of Government of Guam is made to attract alternative power production methods such as OTEC and to strongly encourage conservation practices. Studies carried out by Mobil and British Petroleum mark 1990 as the year when demand for crude begins to outstrip production. Only 12 years remains until that date, during the course of which Guam's population, industry and overall demand for power continue to rely on petroleum. According to the Mobil study, desire of oil-exporting nations to hold production below capacity could advance the shortage era to as early as the mid-1980's. (Petroleum Encyclopedia, 1977). Generating plants must be designed such that fuel supplies can be guaranteed for the life of the plant, usually 30 years. A Chase Manhattan Bank subsidiary predicted that world-wide petroleum consumption will grow at 3% per year, and starting in 1980 crude prices will grow at 2% faster than inflation and increase steadily in the 1980's as the world productive capacity is reached. Presently GORCO pays between $12.00 to $12.80 per barrel for Persian crude. This is up from $2.59 per barrel in January of 1973. Of equal concern has been the eroding position of the U.S. dollar as the oil-price yardstick. Abandonment of this could mean that OPEC countries may not even accept U.S. dollars as payment for oil, although Saudi Arabia has assured the U.S. that it will continue.

The economics of Guam's industries and businesses must plan the continued escalation of energy costs, and the people of Guam in their domestic situations must recognize that continued increases in power dependency, etc. may eventually erode quality of life on the island. Recent GPA expansion plans indicate that all expansion will be self-financing, eg. long term bonds issued on the future-pay back of customers. The penalties for an economy and social structure based on petroleum derived energy have been interwoven with Guam's relatively urbanized lifestyle. Unfortunately, these costs cannot be offset by the CEIP program as the burdens are not being caused by increasing costs of public facilities resulting from energy facility expansion, but by the very reliance on a diminishing resource in the face of a world-wide demand increase.

### F. Visual Impacts

Like the countenance of an ugly duckling, the appearance of most energy facilities appeals mostly to its creators. Power generating units are large and unattractive as are transmission lines and bulk storage tanks. Guam's master planning effort in land-use and parks and recreation have addressed locational and profile considerations for energy facilities. With the possible exception of location of certain transmission lines, Guam's bulk storage, refining, and production facilities are fairly well separated from areas of highly conflicting use. Even though the Cabras and Piti plants are highly visible, it is an area which is primarily commercial/industrial in nature, and whose use has not significantly prevented multiple use and recreational use from occurring. A notable exception could be Bechtel's port master plan which placed a (proposed) "boatel" within the property lines already designated for future expansion of power-plant bulk storage facilities. Others include the placement of high visibility transmission lines through the middle of residential and conservation (open space) areas, and the construction of lines and access roads across wetlands. Often situations like this occur as a result of the lack of lead time-planning.

The GORCO refinery, even when expanded to its projected 50,000 bpd size, is one of the best camouflaged operations on the island, and demonstrates the beneficial aspects of good siting, further wetland intrusion notwithstanding. Double rows of power poles on either side of Marine Drive are unfortunate visual blights, however, until some as yet undiscovered source can provide approximately 10 times the construction funds for underground placement, they will remain.

Certain power personnel favor scattered power-plant sites of the Tanguisson type as one solution to visual and locational difficulties, while others prefer location of production facilities in one spot with easy access to fuel and support facilities as the best means of solving pollution as well as concentrating visual impacts in a particular area.

Suggested use of plants and shrubbery to mask such unattractive facilities as busbars (at port entrance) and village substations is not favorably received from most power people based on defined responsibilities. We would suggest that this type of activity should originate at the community or island-beautification level for facilities not subject to newer more stringent siting controls.

## IV. Mitigation Measures for Major Environmental Impacts

## IV. Mitigation Measures for Major Environmental Impacts

This chapter will briefly discuss a number of methods available to mitigate some of the more controversial impacts associated with electric power production. It is not the intent of this discussion to specifically recommend that such methods be employed on Guam, but rather to inform decision makers of the options available if it is decided that effects or present and proposed energy facilities are unacceptable. A number of methods available are not suitable for either economic or resource-availability reasons. While it is the responsibility of the industry or agency to adhere to environmental standards, and to the maximum extent possible not degrade ambient natural conditions, the costs (including environmental) of such control measures must be passed to the consumer if the Power Authority is to maintain an operational efficiency anywhere near break-even.

### A. Thermal Effluent

#### 1. Cooling Water

The purpose of cooling or circulating water in steam power plants is to condense steam exhausted off the turbine. Cooling water required for this purpose increases in temperature 10 to 15°F. About 100 lbs. of cooling water is needed per pound of steam condensed. A cooling water supply is thus required which is 100 times larger than the flow rate of steam exhausted to the condenser. In the past, cooling water demands were met by simply locating a power plant adjacent to a readily available and abundant water supply. However, significant environmental damage occurs as a result of heated effluent raising ambient temperatures of receiving water beyond the tolerance of organisms within the plume.

2. Atmospheric Cooling

Methods for reducing hot water effluent impacts can be divided into 2 major groups; atmospheric cooling (towers, lagoons) and modified intake or outfall structures.

For plants less 200/MW capacity, mechanical or induced (i-d) draft cooling towers can be employed. The concept of cooling towers was developed to serve areas with limited water supplies whereby cooling water follows a more-or-less closed system between the condenser and the heat transfer mechanism, the tower or lagoon. A portion of the heated cooling water in the lagoon system or wet type cooling tower is lost through evaporation. Fresh water used in atmospheric cooling systems because of the obvious problem of salt residue in evaporation processes.

3. Wet and Dry Type Mechanical (Induced) Draft Cooling

a. Wet Type (Fig. 10) Hot cooling water from the main condenser is fed into a distributing "header" (D), falls through holes in a pan onto a dense framework of wooden slats (C) below. The water is broken up into small droplets and creates a thin film over the surface of the slats. Air drawn in through side louvers (A) by means of large i-d fans

(B). The draft carries away vapor created by evaporation as the droplets fall from slat to slat. Cooled water falls to collecting basin at base of tower. About 75% of the cooling takes place through evaporation and the remainder by heat transfer (conduction) to the air.

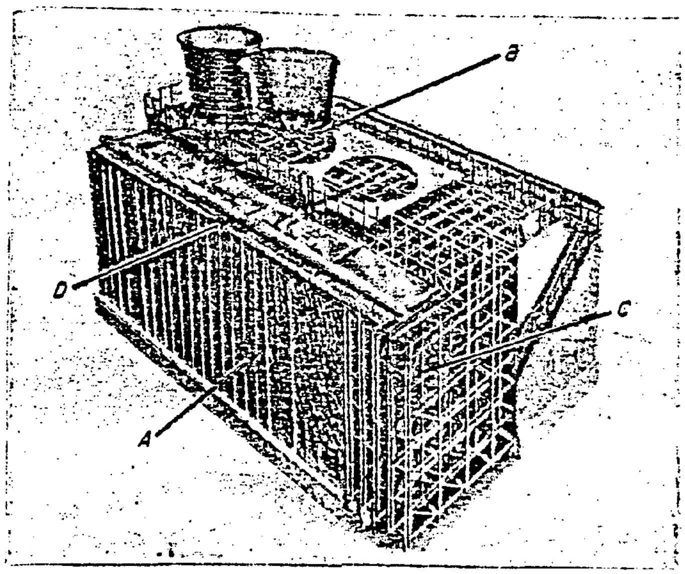



Figure 10: Wet Type Mechanical Draft Cooling Tower

Humidity is an extremely important consideration, along with air temperature. The primary performance factor is how close the cooled water temperature in the collecting basin can approach the wet-bulb temperature of cooling air entering the tower. The higher the relative humidity the less efficient the evaporation and heat transfer rates of the tower.

Advantages:

effluent impact: cooling tower would eliminate heated effluent impacts on the Piti channel & Tanguisson reef-front areas.

dredging: eliminates the need for dredging of intake and outfall channels.

Disadvantages:

space: a rough estimate for Cabras cooling towers for 3x66MW units might be as much as 3 times the area occupied by the present 2x66MW units.

fresh water: Salt water cannot be used in wet type cooling because of salt residue resulting from evaporation processes. Water requirements would be approximately equal the amount of steam exhausted by the turbine. At average daily rate this "make-up" water would amount to some 20 gal/MW or 1.3 million gallons per day. Based on an estimated 1978 island wide capacity of some 30 million gallons per day from all sources, cooling for just the existing 2x66MW Cabras plants by this method might require as much as 4.3% of the island's total water production. Compared to the salt water requirement of some 138.2 million gallons per day (over 100 times the fresh water requirement), this appears quite small, but when considered in terms of limited fresh-water resources, it is far from a workable solution.

cost: The cooling towers alone are roughly estimated to have a price tag which could approach 20% of the total cost of power plant with an ocean water cooling system, not counting additional land requirements.

efficiency: With an annual average relative humidity of at least 66% every month, with night time levels commonly at 84% year round, and with air temperatures rarely

| | |
|---|---|
| | falling below 72°F, Guam is not an ideal location for i-d cooling. |
| visual/other: | High profile, blocklike structure, large steam plumes. Plumes contain bio fouling chemicals and others concentrated in the evaporation process. |
| noise: | Like a squadron of helicopters at 200 feet. |

b. <u>Dry Type</u>: A "dry type" mechanical or induced draft cooling tower works on much the same principle as an engine radiator. Without going into detail, the costs of such a system given the hardware requirements would be much higher than the wet-type, and even less efficient. This limits the ability of the plant at theoretical maximum (which is impossible to attain) to cool hot condenser water to dry-bulb or actual temperature is 85°F, this is the theoretical minimum temperature to which the water can be cooled; under actual conditions the water could be cooled only to 92-95°F.

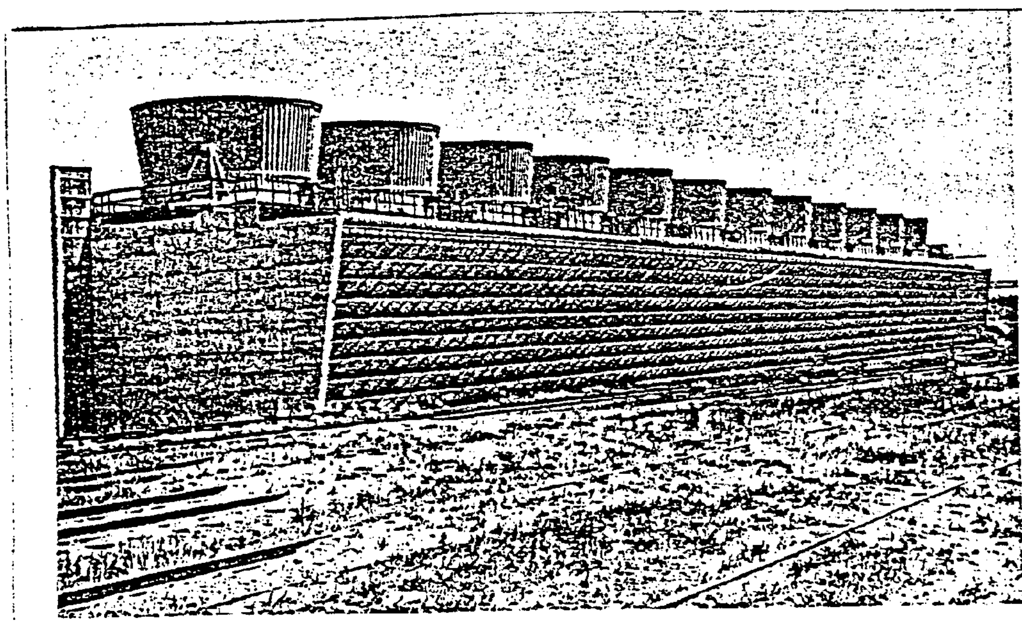


Fig. 11 Public Service Company of Colorado, Cherokee Unit No. 4 cooling tower, 180,000 gpm., 350-mw unit.

(Photograph by Public Service Company of Colorado)

Advantages:

| | |
|---|---|
| effluent impact: | dry-type cooling tower, like the wet-type would eliminate heated effluent impacts on the marine environment. |
| water demand: | the dry-type tower is a closed system running on nearly pure fresh water. Elimination of direct atmospheric cooling means the need for "make-up" water is eliminated for all practical purposes. |

Disadvantages:

| | |
|---|---|
| space: | lower efficiency of dry tower would require more space than wet-type tower. |
| cost: | dry cooling tower cost could approach 30% of the total plant cost. |
| efficiency: | efficiency of a dry type tower on Guam would limit cooling to 7-10°F above ambient air temperature. |
| existing equipment write-off: | same as wet-type |
| noise: | same as wet-type |
| visual impact: | approximately the same structure, steam plume is absent. |
| power consumption: | high |

4. Lagoons/cooling Ponds

A lagoon or cooling pond like the towers, serves as a heat sink which transfers thermal energy developed during the plant cycle to the atmosphere via thermal radiation, or conduction, and by evaporation. This is not a new concept having been actively investigated since 1927.

Factors for consideration include solar and atmospheric radiation, amount of condenser water (hot) entering the lagoon, ambient pond temperatures, amount of rainfall, pond inflow or makeup water, relative humidity, shape and depth of the pond, wind speed, of inflow and outflow geometry, and number and type of induced heat and exchange aides such as aerators and agitators.

Limiting factors are space amount of solar radiation, makeup water, and depth. Studies have shown that shallow water temperatures on Guam often equal or exceed outfall temperatures due to solar heating. Area required for ponds without captial intensive sprays on agitators vary between 1 and 4 acres per megawatt of production capacity. As these estimates are based on plants in temperate climates having cold winters and constant, relatively low water inflow temperature, Guam area requirements would probably be closer to the 3-5 acre range. For Cabras island, the existing 2x66MW plant plus the proposed unit would require almost 100 acres of ponding basin of ±15 foot depth, while required watershed to supply the basin is ten times that much.

With addition of mechanical agitators or sprays the area could be reduced, but the capital investment could easily double the cost of the installation. Unless parts of the harbor itself are used in combination with increasing inflow with perhaps additional tide-gated culverts from the Tepungan channel, the cooling pond approach does not seem particularly attractive. For an area such as Tanguisson, a cooling pond would create major difficulties since the entire pond would have to be dredged or excavated, and inflow or makeup water is absent except for peripheral lens seepage.

> "In one recent estimate, cooling ponds would be expected to increase generating costs by perhaps 15%, and dry-towers perhaps 30%, with evaporative towers in between. In terms of billings to the public, installation of those heat dissipation methods could increase the retail rate from 5 to 10 percent."
> (Reitze, 1974)

### 5. Modified Intake/Outfall Structures

#### a. By-pass cooling

Direct pumping of intake water to the outfall, effectively by-passing the plant itself could halve the Delta T if pumped at the same rate as the intake inflow. According to GPA sources, this would probably be the least expensive method of lowering the temperature differential, but would require a mixing basin large enough and deep enough to achieve pond mixing.

EPA officials are uncertain at present as to enforcement procedures of the 1.5°C Delta T required by water quality standards. It may be that bypass cooling installations would actually cause greater permanent damage to the reef system than the hot effluent from the Tanguisson plant does now. If mitigation measures were required, it is possible that halving the existing differential might be acceptable.

To meet the 1.5°F (0.9°C) range presently required from the existing Tanguisson differential of 6.6°C-7.6°C, a volume of mixing water equal approximately eight times the present 35,000gpm or 280,000gpm is needed. In addition to excessive cost, it is probable that significant enlargement of the intake channel would be required as well as an excessively large mixing pond. The cost of such an installation would be high, perhaps in the $7-8 million range.

A smaller installation, such as one halving the existing temperature would require additional pumps of the same capacity as existing intake pumps, a mixing pool adjacent to the outfall, and either an induction system or a mechanical mixing system. Minimum size of the pool would be in the 100'x40'x15' range. Mechanical mixing would probably be more effective than an induction system and might require 2 or 3 large propellers or other agitation machinery. Such an installation is roughly estimated to increase station service power requirements from ±1.5% up as high as 3 to 3 1/2%. This means that busbar power or power available to consumers (as well as station revenue) would decrease by as much as 2%.

For a location such as Tanguisson, the environmental impact could be that a greater area is destroyed than is presently effected by heated effluent. In addition, unlike equipment life itself, the shore structures, channels and intake pipes would be permanent, existing long after the plant has ceased operations. Over a period of years, this additional cost would be considerable. Construction costs alone could reach $4 million.

b. Intake Modification

It is uncertain at present whether or not a deep outfall would meet EPA requirements since the temperature differential would actually increase directly proportional to the depth, even though actual impact on marine organisms may be substantially lessened.

If deep ocean outfalls would not be acceptable, a deep intake line could lower the temperature of intake water sufficiently to meet EPA requirements. This would be an expensive and technologically innovative approach since no intake channels or pipes in the world reach to depths even approaching what would be required at present flow rates.

For example, one alternative discussed involved the placement of two 42-inch pipes to a depth of 500 feet at a 45° slope directly off the Piti intake channel at Cabras Island. Cooling water could be drawn in at approximately 25°C (77°F), which is 5°C (9°F) cooler than the ambient surface temperature of 30°C (86°F). The exit temperature of the effluent would be in the 29-30"C (86°F) range, thus, meeting EPA standards. Over 2700 feet of 43-inch pipe would be required; 2 x 750' to reach a 500 foot depth, and an additional 2 x 600' to run from the end of the channel to the plant.

Four additional pumps approximately the same size as the existing pumps could be arranged in a connected double-y configuration such that both condensers could be operated (at a reduced rate) for maintenance and cleaning. Open channels would not be practicable given atmospheric heating effects, thus, as indicated above, the pipes would have to be run the entire length of the intake channel.

The cost of such an undertaking would be extreme. Given the fact that nothing of a similar nature has been attempted, it can be assumed that actual costs would exceed estimates based on conventional construction practices and equipment. It is not possible within the scope of this study to accurately cost the project.

B. $SO_2$ Removal

1. Low Sulfur Fuel

The simplest method for eliminating $SO_2$ emissions, though presently most expensive in terms of fuel cost, is to burn low sulfur fuel rather than the present relatively high sulfur (2-2.5%) residual fuel oil. GPA has already looked into this alternative based on a continuous survey of a large number of companies asked to submit bids for low sulfur fuel. This investigation is a part of the ongoing District Court deliberations. Latest results are outlined in a May 12, 1978 report. Out of the companies asked, only one, GORCO, submitted a proposal to supply low sulfur fuel.

Based on present cost, a minimum of <u>$11 million</u> would be added to fuel costs alone during the first year. In addition, GPA would have to provide guarantee deposits of an estimated $6.6 million. These figures do not include the cost of new equipment such as pipeline heaters required as a result of a high paraffin content of the low sulfur crude.

There is also a question if importation of crude priced some 35% higher than existing fuels would be in line with present national efforts to reduce U.S. expenditures on imported petroleum.

GORCO, having submitted the sole bid, is continuing its investigation relative to low sulfur fuel logistics and equipment problems. If present trends continue, it is reasonable to expect the price of high sulfur crude to begin to approach that of low sulfur crude, thus making the installation of expensive scrubbing equipment questionable as the price differential decreases.

This situation bears close scrutiny, and would support the adoption of a wait-and-see attitude rather than a buy-equipment-now approach.

2. Seawater Scrubbing

GPA is actively pursuing the application of innovative technology for $SO_2$ controls, if required. Based on the principle that the natural alkalinity of seawater can be used for the absorption of $SO_2$ without the myriad of problems caused by lime scrubbing and other methods, Guam is felt to be an ideal location for this process. Although the processes are slightly different, similar systems have been used on Australian zinc smelters since 1949, and on London's Battersea Power Station since 1934.

Generally speaking, an ocean water scrubber is a short-circuit of the natural $SO_2$ cycle. The objective is to transfer $SO_2$ from the atmosphere, where it is considered a serious problem, to the sea where its affects are mostly diminished. This short circuit eliminates airborne $SO_2$ and whatever little acid deposition would occur on Guam.

The immediate concern should be the effects of increased $SO_2$ in a volume of seawater:

1. The sulfur content of the water is increased by 20%;

2. The absorbed $SO_2$ occurs mainly as sulfite at first but slowly reforms to sulfate using $O_2$ in the receiving waters. This effectively lowers the COD or chemical oxygen demand.

3. The ph of the seawater is lowered from it's usual level of 7.5-8.5 to 6.

4. Other elements, including trace amounts of nickle and vandium are collected in the seawater scrubbing process.

The main problems here are the lowered COD and ph. Sulfur content per se does not appear as a main concern although details are lacking. The simplest method of replacing oxygen is aeration. An aeration basin would be required a part of the scrubber together with a substantial mixing with ambient seawater or passage through an alkaline bed for restoration of ph. An aeration basin capable of handling a 120,000 gpm flow with a retention time of about 30 minutes is estimated to have a size of approximately 200' x 150'x 15'.

Costing (without site specific details) came to approximately $4.7 million for the two existing Cabras plants as of April '78. Construction time was estimated at 17-23 months. Direct costs per year were estimated to be in the $1.3 million range.

Because of the system's ability to collect trace heavy metals in the process, as well as the increased sulfur content of the water, direct transport to the open sea is strongly suggested. This is mostly to prevent buildup over extended periods of time of elements which could have detrimental effects on receiving waters not subject to constant and high-volume mixing.

### 3. Other $SO_2$ Removal Systems

A number of process, more than 50 and their major variations, are commercially available for sulfur dioxide removal. Despite claims to the contrary, all appear to have significant operational, environmental, and capital costs. This section will briefly discuss, some of these methods but cannot recommend the adoption of any particular system given the extreme complexity of environmental engineering and capital considerations involved. Material has been taken from various papers and technical documents presented at a USEPA/ Control Systems Lab sponsored Symposium on Fuel Gas Desulfurization held in late 1974 in Atlanta, Georgia. The complete conference papers are in the Guam EPA library. Sources are credited only when material is taken directly. Despite the age of the material, few really new processes appear to have shown promise with the notable exception of seawater scrubbing.

4. Brief Discussion of Selected Systems

a. Direct Oxidation - Contact Sulfuric Acid

This process basically passes the flue gas through a fixed catalyst bed where sulfur dioxide ($SO_2$), in the presence of oxygen, is converted to $SO_3$ and then absorbed by sulfuric acid in an absorption tower. Monsanto has developed a modification of the process such that the "strong $SO_2$ is not required, but rather will operate on the dilute $SO_2$ concentration in plant stacks. The modification however is based on the fact that the stack gas enter the process at high temperature (850°F) or be heated to that temperature. The Cabras plants have a stack gas temperature in the 300°F range. The Monsanto process (cat-ox or catalytic oxidation) would be required for these plants, meaning extensive and expensive plant modification, in addition to handling and disposing of sulfuric acid. Startup and operational problems have prevented efficient operation of some pilot projects.

b. Absorption/Stripping

Sodium Base Scrubbing (Wellman-Lord Process)

Flue gas is absorbed into a solution of sulfite, bisulfite, and sulfate, converting some sulfite to bisulfite and some of the absorbed $SO_2$ to sulfate. Pure gaseous $SO_2$ is aerated in the scrubbing process and can be further processed to liquid $SO_2$, sulfur, and sulfuric acid. Sulfate formed in the process must be removed as purge (or waste) together with thionates and thiosulphates. Although the process itself is relatively simple, and the scrubbing agent is re-created during the process, the main disadvantage is with the contaminates resulting, and their disposal. Further research is underway for improving the system. Odor, of course, is another major problem in any processes creating sulfur as a by-product.

Ammonia Scrubbing

Also called the Ammonium Bisulfate Regeneration Process, this system uses an ammoniacal solution rather than sodium to absorb $SO_2$ from flue gases, and to regenerate the scrubbing agent. Acid is added to the final solution to produce ammonium sulfate, a fertilizer, and evolved $SO_2$ is used in the production of sulfuric acid. Again, the scrubbing agent must be imported and the products exported; the system requires large amounts of power, the chemicals are explosive, and the equipment expensive.

c. Wet Lime/Limestone Systems

Limestone Scrubber

Flue gas is contacted to a slurry of water and finely-ground limestone. Scrubber discharge goes partly to settling pond where solid sludge settles, overflow from pond or part of scrubber discharge is recycled to scrubber.

Lime Scrubber

The same as above, except that lime is used rather than limestone.

d. Dry Limestone Injection

Pulverized limestone is injected directly into the power plant boiler, similar to wet limestone/boiler injection, above. Rather than pass through a slurry scrubber, however, the limestone calcined to lime reacts at high temperature with the $SO_2$ and excess $O_2$ in the boiler and forms calcium sulfate which is removed as a solid by mechanical precipitators. Problems include low removal efficiency, boiler plugging and degraded precipitator performance, resulting from higher dust loading. Guam's power plants are not equipped with electrostatic precipitators, as fly-ash is absent from boiler fuel, for all practical purposes. Precipitators are used on coal-fired plants.

e. Other Processes

Other processes such as scrubbing flue gas with a soluble alkali and producing an insoluble product such as calcium sulfite are being investigated. Such a process has the advantage of high efficiency, and elimination of scaling, corrosion and plugging problems. The process known as "double alkali scrubbing" regenerates the scrubbing agent with another insoluble alkali such as lime. For Guam, disadvantages would still be waste disposal and alkali import.

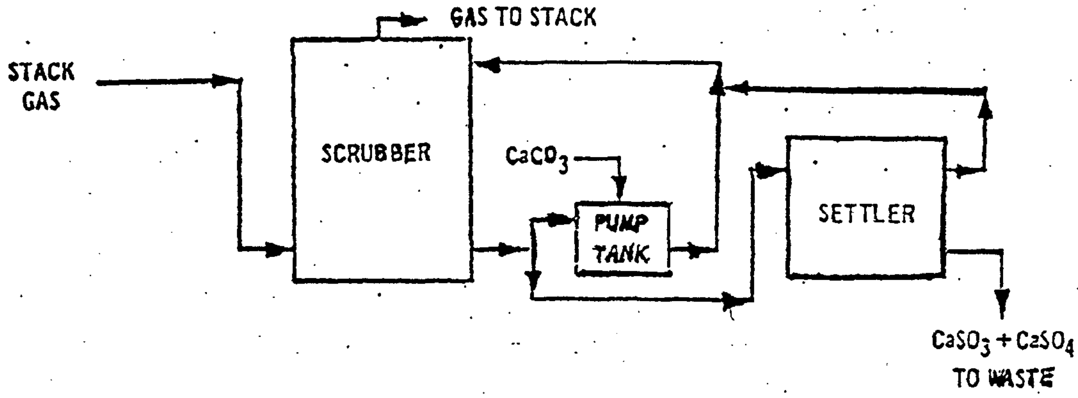
Table 20 : A Selection of Sulfur Oxide Control Methods

| PROCESS | PRODUCT | PROBLEMS |
|---|---|---|
| 1. Direct oxidation<br>Contact Sulfuric Acid (modified Cat-ox process) | Sulfuric Acid | Product difficult to handle; expensive to transport; hard to store; limited local market; stack gas heating required; questionable reliability |
| 2. Absorption/Stripping<br>Ammonia Scrubber<br>Sodium Sulfite/bisulfite | Strong $SO_2$ | High energy consumption; limited $SO_2$ market; sulfate and polythionate/thiosulfate disposal required; expensive |
| 3. Direct Reduction<br>Natural gas<br>Coke<br>Hydrogen | Sulfur | Strong $SO_2$ and low $O_2$; expensive intermediate processes; high secondary emissions |
| 4. Wet Lime/Limestone Scrubbing | Calcium Sludge | Waste disposal; equipment plugging, scaling; secondary pollution; Guam lime not suitable |

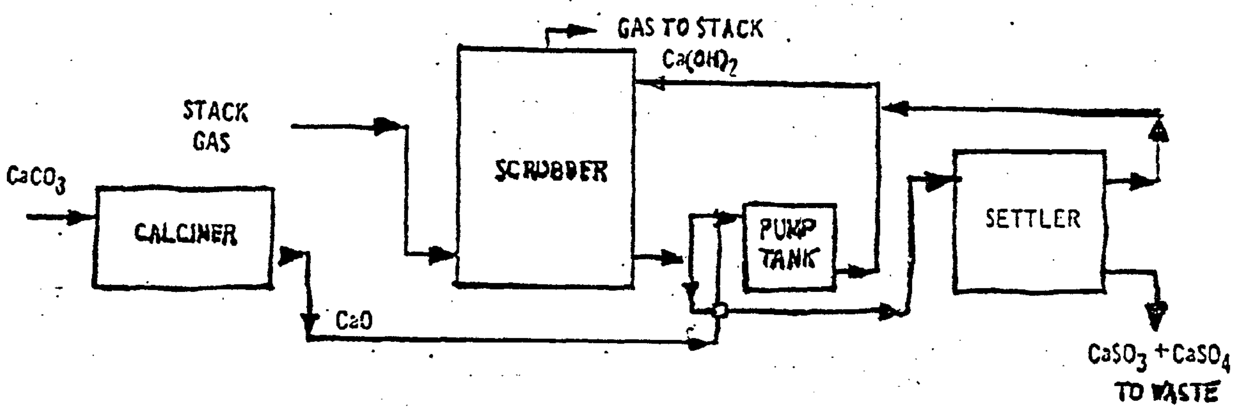
(Arthur G. McKee and Company, 1974)

# V. Measuring the Impacts

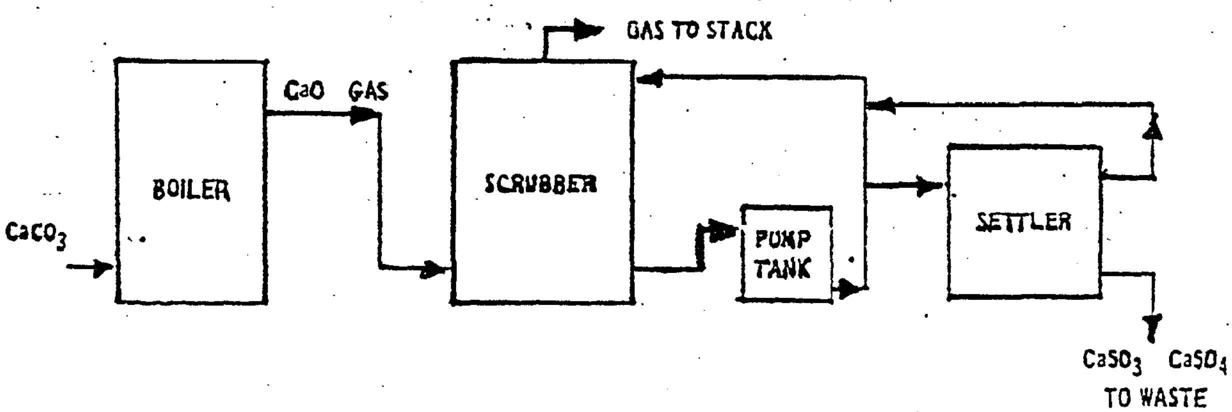
## A Methodology for CEIP Energy Facility Assessment




METHOD 1. SCRUBBER ADDITION OF LIMESTONE




METHOD 2. SCRUBBER ADDITION OF LIME




METHOD 3. BOILER INJECTION

FIGURE 12. Major Process Variations For Use Of Lime Or Limestone For Removal of $SO_2$ From Stack Gases

## V. Measuring the Impacts - A Methodology for CEIP Energy Facility Assessment

Methods for evaluation of impacts by major facility development range from the U.S. Department of the Interior's "Monster Matrix" to EPA's Environmental Impact Statement. While the latter must be prepared as a matter of cause, a method for evaluation of a range of impacts by energy facility development is needed for CEIP and other decision-makers.

For the purposes of this study, a number of "Planning factors" have been derived to consider the most essential economic, environmental and social impacts of proposed energy facility development. Compliance to existing comprehensive plans is a factor considered on a case-by-case basis and is not treated as a separate factor.

### A. Economic

1. Government fiscal condition: Net external change.
2. Employment: Long term, short term, % change.
3. Land values: Changes in a) Surrounding use
   b) Right-of-ways
   c) Aesthetics, pollution

### B. Environmental

4. Air quality: Change in ambient conditions.
5. Water quality: Change in ambient conditions.
6. Audio-electromagnetic: Change in ambient noise and electromagnetic radiation levels.

7. Open space/green areas: Change in existing vegetation.
8. Rare and endangered species: Changes in number or types.
9. Wildlife, vegetation: Major changes in existing abundance or diversity.
10. Disaster: Susceptibility of expanded facility to natural disaster.

C. <u>Social</u>

11. Landmarks: Cultural, historic or scientific landmarks destroyed, significantly altered, or made inaccessible.
12. Recreation: Destruction, or change in "usability" or pleasantness of recreational facilities.
13. Transportation: Change in duration or severity of congestion.
14. Housing: Change in locational demand for nearby housing units.
15. Education: Change in demand for schools, specific courses, student density.
16. Community self perception: Number of people whose community living conditions will be significantly altered.
17. Shortages: Improvement of living conditions caused by previous shortage of energy such as brownouts or forced outages.

## A. Economic Impacts

The economic controversy which always accompanies major investment in new energy facilities is as much a part of Guam's power industry as in any other region. While certain aspects of plant selection and economics of alternative choices are mentioned in sections of this study, the major "economic impact" considerations will revolve around additional public facilities required as a direct result of new or expanded system components. These "externals" or secondary costs are the major focus of the economics section since the major objective is to ascertain what part of the public sector is going to bear the cost burden of these new public facilities, if any. We are assuming that plant costs, method of financing, and general economic well-being of the Guam Power Authority and other private sector participants will be handled as a matter of course. We are only interested in new public facility costs, not in recommending internal fiscal policy of the energy industry.

### Factor 1. Net Change in Local Fiscal Conditions

"Net change" involves computation of expected revenues less operating expenditures, less capital expenditures in public facilities outside of the energy facility itself.

### Revenues

Ideally, revenue projections for assessing external economic impacts for energy development would include a facility's effect on real property revenues (increasing or decreasing tax base directly attributable), changes in income-based revenues (income and sales tax directly attributable), expected changes in population unit revenues (new federal funds generated by the facility), and increased revenues from public utilities.

Operating Expenditures

The term operating expenditures here should not be confused with annual operating costs of the plant itself such as fuel, labor, maintenance, supplies, etc. Operating expenditures here include additional costs in public facilities required including, for example, new sewer or water lines, public safety measures (additional police or fire protection), relocated recreational amenities, new roads, possible upgrading of public transportation. Although change in "educational institutions" has been included under planning factors, it is doubtful if energy facility development will directly result in demand for a new school or library.

Capital Expenditures

Factors include total cost, percentage of total cost allocatable to energy facility expansion and method of financing by the agency responsible. The latter is especially important since, other than planning and environmental grants, the major form of aid offered by the CEI program consists of loans and/or bond guarantees.

Present forms of financing public facility expansion include general revenues from tax receipts (Government of Guam general fund), federal grants, user charges through revenue bonds (bonds issued on the basis of expected revenues), or general obligation bonds for those facilities not paid with user charges.

CEIP loans or bond guarantees could substantially reduce the financial risk to the Government of Guam of new public facilities by underwriting the responsibility of loan or bond payment if such obligations will be dependent on future (and sometimes uncertain) revenues. It is important to take advantage of every penny of support available as this sort of assistance can help to reduce the lag between public infrastructure investment and new revenues from new development.

Factor 2. Employment

Changes in the labor market attributable to major new energy development will include temporary increases in short term A&E, construction and related trades. A greater number of long term plant personnel, both supervisory and operations, will comprise the major long term impacts. A few public sector jobs, particularly in the public safety fire/emergency area may also result. Important for Guam is the origin of this labor and whether it will provide a primary local benefit or merely short run benefits in terms of increased spending of temporarily increased payrolls. The overall result will, hopefully, be a slight decrease in the unemployment rate.

Factor 3. Changes in Land Values

Land value changes usually accompany major energy facility development. On Guam, areas for expansion are usually adjacent to existing facilities, which, for the most part, are surrounded by federally owned or controlled lands. This substantially reduces or dampens any spectacular dollar changes in land values. In a case such as Tanguisson Power Plant, although scenic and recreational value of the area may have been reduced, further commercial and industrial development and increasing earning capacity of the land would not be in accordance with existing community needs or objectives.

For example, the Navy's Guam-land-use plan indicates the return of certain lands at Cabras Island (at fair market price) to the Government and private sectors. Given its location adjacent to the port, as well as existing nearby energy availability, it is doubtful that additional plant capacity at Cabras would substantially increase the land value.

Power transmission corridors can reduce the value of residential, tourism, recreational, or natural areas if improperly or carelessly sited. At best, they may increase the taxable potential of the land because of possible commercial/ industrial development. This is particularly true of power transmission corridors following transportation and other utility corridors. It is often difficult on Guam to gauge such impacts given the often artificially high land values to begin with, as well as sporadic nature of control over development exercised by enforcement agencies and regulatory commissions.

Application of Economic Planning Factors

Because design specifics are not available, economic factors are generally discussed on a case-by-case basis in Chapter VII. dealing with some of the more promising developments which might qualify Guam for CEIP funds. At the time specifics are available, more detailed anlysis will be possible.

B. Environmental Planning Factors

Factor 4. Changes in Water Pollutants

Generating facilities, to date, have been responsible for the major percentage of energy-related water quality impacts although storage tanks and pipelines have the greatest potential. Thermal effluent, suspended and dissolved solids, toxic chemicals, dissolved oxygen and a range of petroleum products, and construction debris constitute the major considerations.

Heated effluent and dredging/filling activities in the past have had the greatest impact on the quality of coastal water. While negative impacts can be accurately assessed at the relatively isolated Tanguisson plant, quality of receiving waters adjacent to the Cabras plant are affected by other activities including commercial port ship operations, previous dredging, and natural processes such as significant solar water heating of shallow reef flats, tend to lessen the overall impact of additional facilities. "Reduction of quality" in receiving waters is generally based upon expected change of existing marine environment as a major index. This could be extremely problematic with a land-based as opposed to floating, "spar-type" OTEC facility. Introduction at the surface of large amounts of extremely cold water (43-44°F) could completely alter the existing regime, even if mixed with the heated effluent from conventional plants. In terms of productivity potential, the cold, nutrient-rich water has incredible possibilities; it is yet an untested case as to whether EPA would consider cold waters with a more than 1.5°F (0.9°C) Delta T to be unacceptable as is apparently the case with the hot water effluent. A floating OTEC plant would avoid this potential impact.

A major risk in development of energy facilities is the threat of oil pollution. This is particularly true of major storage facilities which may require an increase in tanker traffic either through Apra Harbor or near the reefs of Guam (Agat Bay). According to almost all sources, the probability of such an accident approaches 100% over a period of 20 years in areas of medium to heavy tanker traffic. Typhoons and earthquakes increase the risk for such an event.

Factor 5. Changes in Air Quality

Sulfur oxides ($SO_2$) are the main pollutant of petroleum-fired steam plants on Guam. The fuel used to fire the Piti, Tanguisson and Cabras steam plants is a #6 residual fuel oil with a maximum sulfur content of 3.5%, and produces an $SO_2$ stack emission in excess of federal and local ambient standards, which are the same as National Standards.

Although the ambient levels are below the minimum national standards, the problem is with stack emissions. The low ambient levels together with completion of the new Piti stacks, and operation of the "emergency episode plan" (e.g. switching to low sulfur fuel when winds blow stack gas landward) may be acceptable to National EPA until the situation is resolved through the courts.

Factor 6. Audio and Electromagnetic Radiation

Audio quality could be defined as the extent to which noise levels change as a result of increased activity and reduces the desirability of surrounding land areas for particular uses. While not a major problem in the Cabras Island complex, expansion of the Tanguisson and other sites could result in an unacceptable audio level for surrounding recreational uses. Electromagnetic Radiation (EMR) has recently been found to produce severe health hazards over long periods of time. This definitely is a consideration in the location of future high voltage transmission lines adjacent to residential areas, educational institutions, and other facilities in which people consistently congregate.

Factor 7. Open Space/Green Areas

A rather straightforward indication of impact is the amount of land area required for expansion or new development which would directly result in a reduction of existing or potential open space and/or green areas. Submerged lands are considered as open space. Related environmental factors are rare and endangered species (8), wildlife, vegetation (9), and disaster (10).

Factor 8. Rare and Endangered Species

Recent stop-work orders on massive utility projects demonstrate the importance of rare and endangered species in the siting of major facilities. While not expected to present major problems for Guam in terms of limited applicability of the National Endangered Species listing, thought should be given to species endangered at the local level. Local endangered species will be considered in this study's evaluation of expected expansion, and hopefully will be afforded more protection with designation of critical habitats as areas of particular concern under the CZM program.

Factor 9. Plants and Animals, Changes in Abundances and Diversity

Marine fishes, corals, algae, etc., are considered together with terrestrial wildlife and vegetation. Past facility development has resulted in minor to major changes in both the marine and terrestrial regimes. A number of studies provide a basis for projecting impacts. While it is impossible to predict the effect of, for example, an increase of 5% of heated effluent to individual species in an area already affected, it is possible to use a linear expansion to predict the area of additional impact.

Factor 10. Disasters, Natural and Manmade

Guam is subject to frequent typhoon and earthquake hazards and related secondary impacts such as flooding and slumping. In addition, several analyses have been carried out dealing with such things as maximum accidents at hotel wharf ammunition dock and nuclear accidents. For the purposes of this study, war or nuclear events are not considered for obvious reasons, however given the frequency of natural events, both the facility itself and siting considerations are of major importance in establishing a susceptibility factor for expanded energy facilities. The major question here would be, "Is the facility adequately protected?" For CEIP purposes, investment in public safety facilities is of prime importance to minimize the risk to the persons in the immediate area. Additionally, adequate response mechanisms to major spills resulting from disasters is vital.

Factor 11. Recreation

A number of recreational resources ranging from swimming beaches and tourist destinations to potential storm refuge boat anchorage, national park, and major marina are located adjacent or very near to existing and potential power generation and bulk storage facilities.

Most of the island's major critical areas with respect to fragile natural resources, major population centers, and cultural and historic sites should be relatively safe from severe locational impacts of present and future power and energy facilities. What areas do face potential damage can be protected with a modicum of common sense planning.

Parks and recreation officials did not feel that any major recreational or historic resources would be directly threatened by expected energy facility expansion. Provision should be made, it was stated, for continued access to beaches, anchorages and other areas on Cabras Island presently used by the public. Provision for future development should include plans for boating anchorages in the inner Piti channels, especially alteration or addition to transfer pipelines presently limiting access to the channels. Concern was expressed relative to the Agat Bay - Asan - Piti offloading and bulk storage concept as well as any major expansion of the Tanguisson power plant complex. Historic sites such as Inarajan Village, and scenic vistas including Pago Bay, Talofofo Bay and the Facpi Point to Nomna Bay coastal area were singled out as being particularly susceptible to poorly located generation, power pole, or other development. The Department of Parks and Recreation has prepared specific guidelines for transmission facilities.

The following table provides an assessment of recreational and historic resources which are or may be subjected to energy related impacts.

Table 21: Recreational and Historic Resources Potentially Subject to Impacts of Energy Facility Expansion

| Resource Name and Location | Control or Ownership | Existing or Potential Energy Facility | Impact or Potential Impact; Notes |
|---|---|---|---|
| NCS Beach | GovGuam Navy & Private | Tanguisson SSP | Thermal and Air Effluent, Pollution, Shore Structures, Oil Spill (pipeline) Visual, Noise |
| North NCS Beach | Navy | Tanguisson SSP | |
| NCS Reef | Navy (submerged land) | Tanguisson SSP | |
| Puntan dos Amantes Dededo | GovGuam | Tanguisson SSP | Potential Air Pollution (extremely rare with existing plant) |
| Glass Breakwater Apra Harbor | Navy | Cabras/Piti SSP; Esso, Navy, Mobil GPA bulk storage offloading and transfer operations; proposed large scale bulk storage | Air Pollution, Potential Access problems, spill (ship and/or pipeline, bulk storage) |
| Hotel Beach Cabras Island | Navy | " | " |
| Marianas Yacht Club (Private) Cabras Island | Mobil Petroleum (leased) | " | " |
| Apra Harbor Mangroves Sasa & Aguada River Wetlands (Rhizophora sp.) | Navy (submerged land) | " | Shoreline alteration, erosion and siltation are possible with large-scale inland bulk storage complex; oil spill |

Table 21: (continued)

| Resource Name and Location | Control or Ownership | Existing Potential Energy Facility | Impact or Potential Impact; Notes |
|---|---|---|---|
| Jade Shoals | Navy (submerged land) | Cabras/Piti SSP; Esso, Navy, Mobil GPA bulk storage offloading and transfer operations; proposed large scale bulk storage | Possible impact from increased levels of heated effluent; oil spill |
| Piti Channels (adjacent to Cabras SSP) | Navy | Possible OTEC Impacts (speculative) | Possible access problems for proposed storm anchorage; oil spill |
| Luminao Reef | Navy (submerged land) | " | Possible cold water effluent problems (OTEC) |
| Orote Beaches 1,2,3 GabGab Beach | Navy | " | Only probable effect would be from a major oil spill |
| War in Pacific Nat'l Park Asan/Agat | GovGuam, DOI Private | Offshore super tanker offloading & mooring, bulk storage | Visual, oil spill, shoreside facilities |
| Tipalao Beach to Facpi Point (8 beaches) | GovGuam, Private, DOI | Offshore super tanker mooring & offloading facilities | Oil spill, shoreside facility construction (facility very speculative) |
| Scenic Hwys: Agat-Umatac Umatac-Merizo Merizo-Inarajan Inarajan-Talofofo Talofofo-Yigo Bay | GovGuam, Private | 115 and 34.5 KV lines & poles | Possible visual impacts if lines are not properly planned |

Table 21: (continued)

| Resource Name and Location | Control or Ownership | Existing Potential Energy Facility | Impact or Potential Impact; Notes |
| --- | --- | --- | --- |
| Historic Sites: Quarantine Station (1914) | Navy 250 yd West of Piti Channel | Cabras/OTEC expansion | Site disturbance; improbable from energy facility expansion |
| Inarajan Village | Private | 34.5 & 13.8 KV lines | Possible visual impact if lines not properly planned |
| Facpi Point to Nomna Bay | GovGuam Private Federal | 115, 34.5, and 13.8 KV lines and poles; generating facilities | Visual impacts with lines High potential for severe erosion, sedimentation, visual, recreational, thermal, dredging, etc. impacts from generating facility |

## C. Social

### Factor 12. Landmarks: Cultural, Historic, Scientific

Any type of project has the potential of destroying significantly altering, preventing free access, or otherwise impairing landmarks. To date, this has not been serious insofar as energy facilities are concerned. The major problem in the future is with transmission line placement, development of super-port type facilities adjacent to War-in-the-Pacific National Park sites, and possible degradation of areas such as Inarajan Historic District, or the entire southern coastal area. Interviews with University of Guam Marine Laboratory staff and local and national Fish and Wildlife personnel have indicated that a strong tendency exists within the scientific community to consider the coral reefs themselves as scientific landmarks. This, in addition to fairly vigorous EPA water quality standards means that future impacts will be closely monitored.

Whether or not the above categories are presently under national recognition such as national natural landmarks or the national historic register is rather irrelevant other than the additional regulatory muscle it provides. The fact that a site or area is recognized on the local level is adequate to demand special attention by developers.

Because a landmark may be altered is not in itself sufficient to preclude development. The benefit of the facility must be weighed against such things as its rarity, importance to the public, and distance to the closest similar example.

Landmarks:

Cultural/Historic

Inarajan Historic District
Quarantine Station, Cabras Island (1914)
War-in-the-Pacific National Park and specific sites therein.

Scientific

Jade Shoals - Apra Harbor
Apra Harbor Mangroves (between Polaris and Drydock Points)
Atantano and SaSa Wetland
Luminao Reef
NCS Reef Front
Facpi Point

Factor 13. Transportation

Major facilities can have major impacts on transportation patterns. Such things as congestion, interference with future rights-of-way by poles, lines, and transformers, increased traffic flow, or elimination of existing access can all result. Although major flow or congestion problems do not appear to be a major expected impact on land, shipping flow could be substantially increased placing undue pressures on the Port Authority and related Government of Guam services.

Factors 14 and 15. Housing/Education

Not considered to be of major importance, these two factors nevertheless should be considered even if a remote chance exists for additional public facilities and/or educational curriculum changes. Since most residential areas are located far enough away from expansion areas, there is little impact expected, however in the Piti and Agat areas, a major development may cause some problems. It is expected that the new Community College or the existing vocational programs can take care of any additional curriculum demands caused by energy facility development.

Given the size of the island, it is not expected that new housing demand will result from the placement of energy facilities.

Factor 16. Community Self-Perception

More of a value judgement than measurable impact, a simple statement will be made based on the previous factors as to whether the total character of a village or community will be significantly changed as a result of energy facility development.

Factor 17. Shortages

Improvement of a vital service provides social-psychological benefits in that more reliable product results. Improvement or expansion of different segments of the power grid will have a proportionately different effect on elimination of power or energy supply fluctuations or inconsistencies.

# VI Regulatory Considerations

## VI Regulatory Considerations

### A. Overview

Guam, because of its small size, insularity, and limited per capita demand for power due to lack of heavy industry, is not subject to a number of pressures requiring an individual energy industry regulation process. Department of Energy approval (formerly under the jurisdiction of the Federal Power Commission) was not needed for construction of the Cabras 1 & 2 units since interstate transmission was not a factor.

#### 1. Federal Permits

The primary mechanism for review and comment on energy facility development having impacts on waters of the U.S., coastal and otherwise, is the U. S. Army Corps of Engineers permit. Appendix 4 contains a comprehensive listing of those agencies and persons.

#### 2. Local Permits and Review

The process and authorities of local permit procedures have been discussed extensively in the Bureau of Planning's CZM 306 Document, and Barrett and Associates' recent report, "Environmental Management Study". It is not the intent of this report to repeat discussions of points already identified in other studies.

Generally, difficulties in the regulation process revolve around the need for:

a. Clarification of Building Permit, Clearing, Grading Processes;

b. SDRC/TPC/TSPC - Process clarification, understanding of duties, Relationship of Law, Regulations, Authority and Application of same;

c. Clarification of GEPA vs. Federal EPA Environmental Impact Review Process including coordination with Corps of Engineers;

d. Improved Enforcement Procedures.

(Barrett and Associates: Environmental Management Study, 1978)

3. Specificity Definition

With additional guidance in the form of Resort-Hotel, flood-plain and wetland regulations, in addition to existing erosion, emission and water-quality regulations, the on-going task of process clarification should provide Guam with an excellent regulation system for energy facilities.

One resolution needed, according to EPA, is the definition of receiving water. It is difficult to apply a regulation specifying a 1.5° F delta T, if the extent of a mixing zone is not specifically defined. It it is defined as immediately adjacent to the outfall, then we can expect major effluent requirements on existing new source and future facilities.

Emission controls will be facing much the same type of review.

4. National and Territorial Interest

The CZM document, the Comprehensive Development Plan and local regulatory processes recognize both the territorial and national interest in the development and siting of major facilities.

5. Public Facilities Commission

The role of the Public Facilities Commission (once operational) is uncertain at the present time as to participation in the regulation of energy-related matters.

6. APC's (Areas of Particular Concern)

As additional areas of particular concern (APC's) are established and regulations developed, major energy facilities, like all development, must adhere to the extent that local regulatory bodies deem sufficient. Local regulatory commissions must apply regulations in a manner consistent with the program document and the guidelines under which federal funds are being received.

B. Air Quality

1. Legal Arbitration

The process by which Guam shall come into line with federal statutes is contained in the island's State Implementaion Plan (SIP). A series of legal actions in the form of suit and counter-suits are seeking more exact process definition:

- CA. 75-064 GPA vs. Administrator, EPA, Russell Train
- CA. 75-066 US vs. GPA

Results, to date, are not conclusive:

- A compliance order was issued January 30, 1976. This initially set up the Emergency Episode Plan and outlines other procedures for GPA compliance.
- An Interim Consent Order, on January 21,1976, was changed by an Amended Interim Consent

> Order on August 28, 1976, under District Court Decision CA-75-066, and granted relief from immediate compliance with New Source Performance Standards (NSPS) for a period of three years.

Meanwhile, reports on various aspects of the $SO_2$ problem are submitted to the District Court every six months, while various proposals are developed to seek a middle ground for Guam-oriented compliance.

2. GPA Activities

To avoid installation of questionably useful and very expensive scrubbing equipment, GPA has proposed additional time be given for investigation of innovative technology, seawater scrubbing, to solve the $SO_2$ problem, if the courts ultimately decide Guam must adhere to stateside standards. GPA is applying to the District Court for further amendments to prevent assessment of non-compliance penalties based on innovative technology investigation. Concurrently, GPA is applying to GEPA for a DCO (Delayed Compliance Order) to allow for non-compliance with NPDES without penalties, pending studies on the process and the environmental acceptability of seawater scrubbing. Three years are being proposed to study seawater scrubbing, one for determining the data base, and two for studies on critical aquatic organisms and extrapolation of laboratory results for determining actual impacts.

The Clean Air Act Amendments of 1977 raised some questions about Guam procedures. Specifically, Section 113(d)(12) of the Amendments called into question the validity of orders, particularly the Amended Interim Consent Order. In a submission to Honorable Cristobal C. Duenas of the District Court of Guam, GPA's attorney, Hogan and Hartson, raised the question, however, both GPA and GEPA counsels subsequently agreed that the validity of the Amended Interim Consent Order had not been changed.

In other developments, several actions are being proposed:

- Source (rather than area) based data should be developed for sulfur dioxide, relative to terrain dispersion and model certification information. Present measurements do not specifically test the stacks, but rather the general Cabras Island/Commercial Port area.

- Develop and support legislation exempting Guam from $SO_2$ regulations.

C. Water Quality

1. General

Point source discharges are required to adhere to regulations promulgated by GEPA under the National Pollution Discharge Elimination Systems (NPDES). By authority of Guam Public Law 9-76, the Water Pollution Control Act (Title X, Chapter II, Section 9950.5 [b], [e]) of water-quality standards became effective on September 25, 1975. Section II of the regulations established standards for:

- microbiological requirements (fecal coliform)
- pH
- nutrient material
- dissolved oxygen
- total dissolved solids
- salinity and currents
- suspended matter
- turbidity
- radioactive materials
- temperature

- toxic substances
- pesticides

Of major interest to the power industry is Section II b(9) of the regulations which states: "Water temperature shall not be changed more than 1.5° F (.9°C) from natural conditions." This applies to all surface waters except those "flowing over the land (e.g., sheet runoff) or water confined in channels with intermittent flow". (Sec I B[2] [c])

Uniform application of these water-quality regulations under authority granted to GEPA could force a reduction of thermal effluent impact on Guam's coastal waters. The opposing argument, that Guam's encircling waters are a part of the largest heat sink on earth, thus diminishing the relative impact of effluent, has more validity on Guam than in most places. The fact remains that the entire cost of whatever thermal effluent reduction measure is required will be passed on to the consumer. It should, ideally, be left to the local authorities to weigh the benefits of either approach and arrive at an equitable solution. The danger of such a resolution lies in the penchant for local governments, usually with recurring fiscal difficulties, to ignore the long-range impacts in favor of short-run capital investment savings, and to reject any voluntary actions until the situation becomes critical and expensive to redress.

Environmental policy makers, in the face of restricted clean fuels availability and the parallel drive for relaxation of environmental controls, have failed to reach agreement on the national level as to the guidelines for compromise which must occur. Guam EPA is caught in the middle with the unpleasant task of forcing expensive effluent controls on plants in locations whose actual impact is not significant at the island's major production site. Until the definition of mixing zone is specifically addressed, and until (U.S.) Department of Energy and Environmental Protection Agency policy makers decide on the effect of changed conditions, the local dilemma will remain.

### 2. Additional Safeguards

Proposed areas of particular concern (APC's) under the land-use planning effort, building permit and SDRC/TPC/TSPC process clarification, establishment of an adequate seashore reserve, and active participation and review of submerged lands permits, and detailed review and comment within the Corps of Engineers permit-review process provides a more than adequate regulatory framework for maintenance of water quality and protection of fragile resources. The EPA process will continue its efforts to more specifically define the degree of flexibility under the national mandate.

### 3. Other Water-Quality Considerations

The preceding has focused on strict application of controls relative to heated effluent. Application of controls for other pollutants seems reasonable. Some questions may arise if a seawater scrubbing system is contemplated on more than a speculative level. It does appear that both GPA and GEPA are attempting to reach an equitable solution to a difficult problem.

4. <u>Federal Water Pollution Control Act and Amendments (Oil Spills)</u>

The Federal Water Pollution Control Act of 1972 provided new strength for controlling point source discharges of oil and hazardous substances and generally replaced the Refuse Act of 1899. A major weakness of the latter was lack of penalties.

Generally, the FWPCA:

a. prohibits discharge of oil and hazardous substances in U.S. waters;

b. gives EPA jurisdiction over inland spills;

c. requires an FMC (Federal Maritime Commission) certificate for ships indicating type of spill insurance (presently this is $125 per gross ton, or ± $14 million limit);

d. established revolving contingency funds ($20 thousand for Guam) for spills of unknown origin, or as contingency monies for sloppy cleanups by responsible parties;

e. established the national regional strike force to mobilize experts at the site of major spills;

f. established fines for spilling ($5000) and not reporting spills ($10,000).

On Guam, the reaction to enforcement of FWPCA has been excellent. In the first year 36 validations occurred, the second year 19, and last year only 11 incidents occurred, as operators and industry became more cognizant of stiffer penalties.

The Clean Water Act of 1977 strengthened the FWPCA by broadening the definition of U.S. waters to 100 miles, making offenders responsible for the restoring and restocking of natural biota, and increasing the liability of onshore facilities from

$8 to $50 million. Additionally, if a third party were responsible for a spill (the ship's leasee), the owner can prosecute for charges. The law also provided that the contingency fund could be used to avoid a potential spill by offloading or pumping tanks of vessels in trouble.

# VII. <u>General Conclusions, CEI Matrix, Funding Recommendations</u>

## VII. General Conclusions, CEI Matrix, Funding Recommendations

### A. General Conclusions

1. Public facilities on Guam external to Guam Power Authority have not and are not expected to be severely burdened by expected expansion or development of new energy generating and transmission facilities.

2. Environmental quality and availability or access to recreational areas has not been and should not be severely affected by expansion or development of new energy generating and transmission facilities.

3. No in-place plans other than typhoon restoration and very low impact power grid maintenance and development activities were in evidence during the course of this study.

4. Several projects in preliminary planning stages, especially in the refinery and bulk storage sectors could place significant pressures on environmental quality, recreation and conservation, land, and the cost of future public facilities.

5. EPA-mandated control standards will be more precisely defined in the light of Guam's unique conditions.

6. Facility planning and open discussion of projected activities is somewhat restricted among the energy sector's various administrators.

7. Lack of emphasis on lead time planning creates a fluid situation whereby new ideas crop up literally overnight. Proposals could surface any time which may substantially increase Guam's funding eligibility.

### B. CEI Matrix-Funding Possibilities

Energy Facilities in preliminary planning stages may qualify Guam for CEIP funding, particularly planning monies. The lack of in-place plans limits the availability of public facility CEIP aid, however it is expected that several major projects will be on line prior to the 1986 program termination date.

The following matrix indicates the source and possibility of receiving such funds as a result of projected expansion. A discussion of marginal and probable CEIP funding possibilities follows the matrix.

Table 22: CEIP Funding Matrix

Keys:

I. ± 66MW generating unit
  a) Cabras location
  b) Other location

II. Central Terminal Station (CTS)

III. OTEC Plant
  a) Floating Spar
  b) Land Based

IV. Refinery Expansion

V. Powerline Hardening & Expansion

VI. Pipeline Construction

* CEIP Planning Funds (308(c))
1. Negligible - No CEIP $
2. Marginal - Possible CEIP $
3. Significant - Probable CEIP $

| Planning Factors | I a | I b | II | III a | III b | IV | V | VI |
|---|---|---|---|---|---|---|---|---|
| **Economic** | | | | | | | | |
| 1. Net change - Local Fiscal Conditions | | | | | | | | |
| a. Revenues | 1 | 1 | 3 | 2* | 2* | 1 | 1 | 1 |
| b. Operating Expenditures | 2 | 2 | 2 | 2* | 2* | 1 | 1 | 1 |
| c. Capital Expenditures | 2* | 3 | 3 | 2* | 2* | 2* | 1 | 1 |
| 2. Employment | | | | | | | | |
| a. Temporary | 1 | 1 | 2* | 2* | 2* | 1 | 1 | 1 |
| b. Permanent | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3. Land Values - Changes | 1 | 1 | 3* | 1 | 1 | 1 | 1 | 1 |
| **Environmental** | | | | | | | | |
| 4. Water Quality | 2* | 3* | 3* | 3* | 2* | 2* | 1 | 2* |
| 5. Air Quality | 2* | 3* | 1 | 1 | 1 | 2* | 1 | 1 |
| 6. Audio & Electro-magnetic R d | 2* | 3* | 1 | 1 | 1 | 1 | 1 | 1 |
| 7. Open Space/Green Areas | 1 | 3* | 3* | 1 | 2* | 3* | 1 | 1* |
| 8. Rare and Endangered Species | 2* | 3* | 3* | 2* | 2* | 3* | 1 | 2* |
| 9. Plants and Animals | 2* | 3* | 3* | 3* | 2* | 3* | 1 | 2* |
| 10. Disaster Suscepti-bility | 1 | 3* | 3* | 1 | 2* | 1 | 1 | 1 |
| 11. Recreation | 1 | 3* | 3* | 2* | 2* | 1 | 2* | 2* |
| **Social** | | | | | | | | |
| 12. Landmarks | 1 | 3* | 3* | 1 | 1 | 1 | 2* | 1 |
| 13. Transportation | 1 | 1 | 3* | 1 | 1 | 2* | 1 | 1 |
| 14. Housing | 1 | 2* | 2* | 1 | 1 | 1 | 1 | 1 |
| 15. Education | 1 | 1 | 1 | 2* | 2* | 1 | 1 | 1 |
| 16. Community Perception | 1 | 2* | 2* | 1 | 1 | 1 | 2* | 1 |
| 17. Shortages | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

C. Funding Recommendations

1. Generating Facilities (I on chart)

Planning is in preliminary stages, no specific plans are available. Cabras location would reduce overall impacts as land area and infrastructure are available and use is compatible with surrounding uses. Also no additional dredge and fill would be required.

a. Cabras Location, CEIP Funding Possibilities

(1) Additional Public Safety Equipment - fire equipment.

objective: reduce fire hazards in Cabras Island Energy facilities.

authority: Department of Public Safety Chief Wusstig.

present status: Piti Station (GovGuam) has a single basic structural pumper located 1/2 mile from Cabras and Piti generating units, 1 mile from Mobil and Esso storage facilities. No foam unit is readily available. Perhaps 50-75% of the cost of additional units could be attributed to petroleum storage, offloading and electric generating units.

present status: no firm plans; planning funds can be used for:

- operating expenditures: determine ability of DPS to operate an additional unit at Piti, if needed.
- environmental: plan for generating unit's as well as mitigation equipment's impact on air and water quality, marine environment (plants and animals and rare and endangered species).

CEIP funding: 308(c); primary source - the fund. Procedures - same as with present grant. Funds should be applied for when design RFP's are requested, possibly 1983.

Amount: Undetermined; close coordination should be established and maintained with GPA such that CEIP studies do not overlap with GPA studies.

b. Other Locations for Generating Unit

(1) Public Facilities

An Agat or other location may mean a substantial investment in water lines, roads, and other facilities. Depending on specific location, funds under 308(d) (1), (2)

<u>present financing</u>: DPS equipment is wholly funded through general fund. Present federal funds can only be used for communities of less than 10,000 persons, and then only for "minor" equipment.

<u>CEIP funding</u>: 308(d) (1), (2); primary source, the Fund; Procedures - Rules and Regulations Section 931.48.

<u>Amount</u>: (DPS figures)

Basic Pumper - $92,000

Foam Unit, Crash & Rescue Unit - $110-125,000.

<u>Action</u>: Investigate ability of the Department of Public Safety (DPS) to receive federal loans, as well as establishing a repayment process. Obtain more specific needs statement (e.g., projected CIP needs), and investigate implications of Navy ownership of Cabras Island. (See also planning funds below).

(2) <u>Planning Funds - Cabras Location for Generating Unit</u>

<u>objective</u>: determine specific impacts of designed generating facility.

could be applied for. PUAG has recently been granted authority to obtain loans.

Table 23 : Approximate Cost Estimates for Selected Public Facilities (Source: DPW; Barrett & Associates)

| Facility | Size | Cost/Unit |
|---|---|---|
| Roads, Paved[1] | 2 Lane | $ 70,000/1000 ft. |
| H-20-24 Class | 3 Lane | $110,000/1000 ft. |
| 60 tons | 4 Lane | $150,000/1000 ft. |
| (80 ton w/safety factor) | 5 Lane | $190,000/1000 ft. |
| | 6 Lane | $270,000/1000 ft. |

| | | |
|---|---|---|
| Water Lines | 6 inch | $30/ft. |
| | 12 inch | $40/ft. |
| | 16 inch | $45/ft. |

Notes: [1] Road prices are in 1976 $ Units, add 15%/yr. for approximate update (DPW)

2. CTS - Central Terminal Station (II on Matrix)

Discussion of the CTS concept appears in Appendix I . Probability of project realization to the scale envisioned is low, however the economic, environmental, and social impacts are potentially the largest of any civilian sector activity ever proposed for Guam.

Planning funds under 308 (c), would be vital as a first step should the project become a reality, thereafter public facility loans or bond guarantees under 308 (d) (1) & (2) would be probable. The U.S. Coast Guard commander indicated that a sophisticated traffic control system is not presently needed due to low traffic flow, but with a full-sized CTS facility, additional studies would be necessary.

3. <u>OTEC (III on Matrix)</u>

As indicated in the CEIP matrix, a floating spar-type plant would have a significantly smaller environmental impact than a land-based plant.

A suggested use for 1979 CEIP funds allready allotted under 308 (c) would be:

a. coordinating and evaluating all OTEC related studies being carried out relative to a Guam location;

b. more intensive studies of alternative sites for a land-based and sea-based facility. An investigation, "Locational Impacts of Alternative OTEC Facility Sites" would be appropriate at this time. These might include Cabras Island, Agat Bay, and Cocos Island for the spar-type plants. Focus of study might be impact of shore-side support facilities for the installation, and comparison to the greater impacts of a land-based facility of the type proposed by TEPSCO.

4. Refinery Expansion (IV on Matrix)

a. Public Facilities

Noted in Chapter II was the fact that water availability poses a constraint to refinery expansion in the light of the Navy's desire to end the cooperative water supply arrangement now in effect for the Agat-Santa Rita area. The GORCO well presently supplies 1.7 million gallons per month (gpm) and the Navy lines some 255,000-450,000 gpm. Even with the maximum demand, this constitutes only 1.1% of the 39 million gpm presently consumed by the communities of Agat and Santa Rita. This ratio will decrease in the future. Thus it appears that proportioned energy facility contribution to the cost of piped-in Northern-lens or Ugum Dam water, (both schemes being 10 or more years in the future), would be negligible.

b. Planning Funds

Planning funds might be applied to the study of impacts of expanded tankage facilities relative to planning factors 4, 5 and 7-9 as indicated on the matrix. These funds should be applied for when specific design plans are available, again under 308 (c).

5. Powerline Hardening and Expansion (V on Matrix)

These projects being already underway, would be difficult to change. An attempt might be made through cooperation with the Navy and the Department of Parks and Recreation to ensure that projected line hardening in the southern areas do not interfere with land to sea vistas or Inarajan historic district. If this is deemed necessary, a small portion of already allotted 1979 CEIP funds might be used.

6. Pipeline Construction (VI on Matrix)

Present plans are still in discussion stages. Planning 308 (c) funds might be used in 1980 to study impacts on water quality, plants and animals, rare and endangered species, and recreation for alteration of Piti channel pipes, or low sulfur lines projected to run along existing easements from Cabras to GORCO refinery. It should be remembered that these projects will both require a COE permit, and studies, if necessary, should not overlap.

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## H. Personal Correspondence and Interviews

(See Appendix 5 for listing.)

Appendix 1.

Appendix 1

I. Central Terminal Station - Summary

II. OTEC - Ongoing Studies - Discussion

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## I. Central Terminal Station (CTS)

Conceived in response to rejection of a Palau location for a so-called superport, interest generated in the 14th Guam legislature for an alternative location for such a facility resulted in a preliminary study, "Report of the Special Study Commission on the Guam Supertanker Port".

### Proposal

To establish a crude oil transshipment facility on Guam to meet Japanese demand for "a more stabilized and secure source of energy", by construction of a facility capable of storing a 90-day crude supply for Japan.

### Rationale

VLCC & ULCC (Very Large Crude Carrier and Ultra Large Crude Carrier) ship construction of the 250,000 to 500,000 deadweight-ton (DWT) range has made use of traditional routing through the Malacca straits impossible due to maneuverability and draft of vessels. Supertankers must go further south and east to Lombok strait between Borneo and Celebes. The traditional tanker route has thus been shifted east of the Philippines, making a storage facility feasible for Palau, the Philippines or the Mariana Islands.

Requirements

A one-day demand of crude oil for Japan, 4.72 million barrels, would require 7.5 tanks of a 629,000 bbl. capacity. One of these tanks, approximately 2-1/3 times the size of the GPA storage tanks, would require ± 10 acres of flat land. An initial phase of a 20-day supply mentioned in the report would require 150 tanks and 1,500 acres of flat, geologically stable land. The ultimate plan of 90-days' storage capacity would require 675 tanks on 6,750 acres of land. The fact is that no suitable land area exists for such a massive development, without substantially altering tremendous areas of steeply sloped, geologically unstable, conservation-designated land. Details for each potential location are discussed in the report.

Impacts

There are no positive environmental impacts possible under this project. Massive erosion and sedimentation, destruction of wetlands, estuaries, rivers and associated wildlife and water habitats, visual pollution, significant demands on existing public facilities (roads, water) and extreme threats of massive oil spills are a certainty. The fact that Guam is located in one of the most active earthquake zones on earth, where strong earthquakes occur more frequently than in California, should raise a flag of caution to massive development of steep volcanic slopes as should the frequency of typhoons to siting of other energy facilities in flood-prone areas, without adequate wind and water resistant as well as containment capabilities.

Of further interest is the fact that an Agat location for the Cabras generating units, as area with yery similar geological characteristics as the proposed CTS sites, was rejected due to potential erosion problems, geologic stability factors, and associated engineering costs.

Economically, the project would mean a sizeable influx of alien construction workers and very temporary benefits to local industry. Gross receipts taxes are premature to project, since some relaxation or grace period is common to attract such industry in the first place. Additional permanent employment would be marginally beneficial to the island; however, since the project is foreign-owned, it can be assumed that personnel, except in lower-skill jobs, would be from off-island. Such is the case for a much smaller facility located on Bonnair in the Dutch Antilles, north of Venezuela.

Bonnair Facility*- A Brief Comparison

The Bonnair transshipment facility, located just off the coast of Venezuela, transfers Near East Crude brought in on supertankers into 8,660,000 bbl. tanks, to smaller tankers for transshipment to the U. S. The tanks, similar in size to those projected for Guam are 272 feet in diameter and 68 feet tall. "The island was selected for this facility also because it lies well south of hurricane alley...never has been struck by a hurricane...and the last severe tropical storm touched the island in 1886." Four of the facility's 8 main tanks are located less than 600' from the water's edge, on flat, geologically stable

* (Source: CBI News, 5/77)

land. Two supertanker berths lie approximately 500' offshore and about 1200' from the tanks, themselves. Such conditions are not even comparable to those on Guam.

### Study Gaps

While the commission's report establishes the rationale for the project as the necessity of VLCC & ULCC's carrying crude oil east of the Philippines, the opening paragraphs state that "construction of berthing facilities for tankers in excess of 250,000 DWT could never be realized nor could accommodating activities such as refineries (etc.)...be supported here. Later in the report, a distinction between a transshipment facility and a CTS is hinted-at but never discussed. According to port consultants and the U. S. Coast Guard, the feasibility of such a project is very questionable without the use of the large tankers.

### CEIP Funds

Should further investigations continue on the feasibility of the CTS, a large amount of CEIP planning funds should immediately be utilized for impact investigation. Given the investment even for initial phases as well as potential impacts, a good deal of funding should be available under Section 308 (c). Application should be made as soon as further studies are completed, giving more than a speculative basis for the CTS.

## II. OTEC - Ongoing Studies - Discussion

### Local OTEC Studies, Projects

Two ongoing studies have been funded by the Guam Energy Office in addition to a recent series of proposals developing through the University of California's Berkeley Lawrence Laboratory.

OTEC Data Search, R. Randall, UOG Marine Lab, ±$11,000; by November, 1978

Purpose: Temperature levels to 3,000 feet, water chemistry, slope and bottom topography, bottom substrate and ocean current study review.

Comments: Preliminary partial summary of findings available August, 1978, Dennis Lassuy (graduate student) assisting on project.

Biofouling Studies, Dr. C. Birkland, UOG Marine Lab ±$3700

Purpose: Examine rate of slime formation, bacterial growth, and calcium carbonate disposition; correlation of data with Guam biofouling rate with other regions.

Comments: Slow start due to administrative financial problems. In a related activity, a representative from Battelle visited Guam December 1, 1977, for initial DOE biofouling experimental facility location.

The only results from this visit appear to be a disclaimer by the Battelle representative that any commitments were made to locate the facility here. (2/8/78)

Department of Energy (DOE)

DOE is actively involved in range of OTEC feasibility studies. Federal funds continue to be awarded for technical, economic, financial, legal, and planning aspects of OTEC development, several criteria for which Guam more than qualifies when compared with other potential sites.

Two problems are evident in the securing by local firms of DOE/OTEC grants. One is concerned with general ignorance on the part of Washington people and its contractors that Guam not only exists, but should be a prime candidate for OTEC location. GEO and GPA recognize this "low visibility" problem and are investigating methods of solution.

In fairness to the federal government, however, erroneous impressions of Guam's potential could be partially attributed to a questionably accurate report prepared by the U. S. Navy and not coordinated with local expertise or Gov Guam (1975: "Suitability of Guam from an Environmental Aspect as a Potential Site for OTEC Plants") which stated essentially that OTEC plants on Guam are not feasible due to adverse effects of cold effluent surface discharge on warm water near-shore flora and fauna. The second problem may be that local A & E firms are simply not receiving RFP's from DOE. Often even the RFP's that do reach Guam are several weeks late, making widespread distribution impossible. Obviously, local conditions are best known by local firms, especially such things as economic, demographic, financial and social conditions. Presently, increasing interest is being generated for Guam, mostly because of irrefutable data indicating site superiority over other locations. Lacking is knowledgeable and vigorous Washington, D. C., representation as well as a financial commitment by Gov Guam to OTEC (Hawaii recently appropriated some $10 million for such activities).

DOE RFP's which have reached Guam, albeit rather late for serious consideration include:

1. RFP #784406, Argonne National Laboratory, for "Design and Construction of an OTEC Seacoast Test Facility". (Only 45 days to analyze, distribute, prepare and send proposals.) Action letter sent to Argonne subcontractor indicating inadequate time period but a continuing interest.
2. RFP #ET-78-R-02-0019, DOE Chicago Operations Office, "Electric Utility System Planning Studies for OTEC Power Integration". (Extension to October 2, 1978, granted to Guam for RFP preparation.)

The latest development is that Fairchild's Stratos Division has been awarded the contract and that Guam, through a contract amendment coordinated by Dillingham Corporation, will be included as a participant together with Hawaii and Florida. Further details should be available shortly through W. F. Pinckert and Associates.

Berkeley Lawrence Laboratory - Department of Energy Research - Four-Phase Study

Discussion:

Lawrence Laboratory has been contracted by the Department of Energy to evaluate "Bio-ecological Concerns" of OTEC development. Guam's involvement could be in several increments:

1. Literature Search (Tentatively Approved - $10-15,000): Exhaustive review of biological-ecological data presently available which would be of value for OTEC development. (UOG Marine Lab)
2. Data Collection: Based on literature search, establish program for "standard bi-monthly measurements" for such things as temperature, chemistry, and current variations and seasonality effects. Shipboard time will have to be contracted out. Effort will be made to utilize Guam expertise. Proposal required by seventh month of Phase I.
3. Long-term Data Collection: Establishment and maintenance of "augmented measurements" program. Phase II data evaluated and ongoing monitoring system established. This would continue even after plant construction.
4. Final Writeup: Sum total of data evaluated in final form, probably would be the basis for plant construction. Time frame uncertain at present time.

Tokyo Electric Power Services Company (TEPSCO)

One OTEC possibility involved the discussion of a Japan-based firm to construct a plant on Guam. A very preliminary discussion paper was prepared by TEPSCO for the siting on Guam of a cost of some $32 million for a land-based 4 x 2.5 MW plant. Further discussions indicated that a DOE/GPA/TEPSCO coordinated effort was not feasible under present plans. The current status of the project is uncertain.

Appendix 2.

Appendix 2

Islandwide Power System - Approximate averages for peak demand (KW) 1972-1978

| | MONTH | MTHLY AVERAGE | QTRLY AVERAGE | 6 MOS AVERAGE | ANNUAL AVERAGE |
|---|---|---|---|---|---|
| 1972 | | | | | |
| | Jan | 118,350 | | | |
| | Feb | 120,800 | 120,800 | | |
| | Mar | 120,800 | | | |
| | Apr | 125,000 | | 123,600 | |
| | May | 126,400 | 126,400 | | |
| | Jun | 127,900 | | | 131,100 |
| | Jul | 131,300 | | | |
| | Aug | 133,000 | 135,200 | | |
| | Sep | 141,200 | | 138,600 | |
| | Oct | 144,400 | | | |
| | Nov | 142,000 | 142,000 | | |
| | Dec | 139,500 | | | |
| 1973 | | | | | |
| | Jan | 134,900 | | | |
| | Feb | 134,700 | 136,500 | | |
| | Mar | 140,000 | | | |
| | Apr | 144,700 | | 140,800 | |
| | May | 147,200 | 145,000 | | |
| | Jun | 143,200 | | | 142,200 |
| | Jul | 146,600 | | | |
| | Aug | 146,300 | 148,300 | 143,600 | |
| | Sep | 151,900 | | | |
| | Oct | 151,800 | | | |
| | Nov | 151,100 * | 147,000 | | |

| | MONTH | MTHLY AVERAGE | QTRLY AVERAGE | 6 MOS AVERAGE | ANNUAL AVERAGE |
|---|---|---|---|---|---|
| 1974 | | | | | |
| | Jan | 126,500 | | | |
| | Feb | 132,700 | 132,800 | | |
| | Mar | 139,100 | | 138,500 | |
| | Apr | 144,100 | | | |
| | May | 143,700 | 144,300 | | |
| | Jun | 145,000 | | | 144,800 |
| | Jul | 142,900 | | | |
| | Aug | 149,600 | 148,400 | | |
| | Sep | 152,800 | | 151,100 | |
| | Oct | 156,600 | | | |
| | Nov | 154,600 | 153,700 | | |
| | Dec | 150,000 | | | |
| 1975 | | | | | |
| | Jan | 143,300 | | | |
| | Feb | 141,000 | 143,300 | | |
| | Mar | 145,600 | | 146,800 | |
| | Apr | 147,500 | | | |
| | May | 153,200 | 150,300 | | |
| | Jun | 150,300 | | | 147,500 |
| | Jul | 143,600 | | | |
| | Aug | 144,100 | 145,900 | | |
| | Sep | 150,000 | | 148,200 | |
| | Oct | 153,900 | | | |
| | Nov | 147,600 | 150,500 | | |
| | Dec | 150,000 | | | |

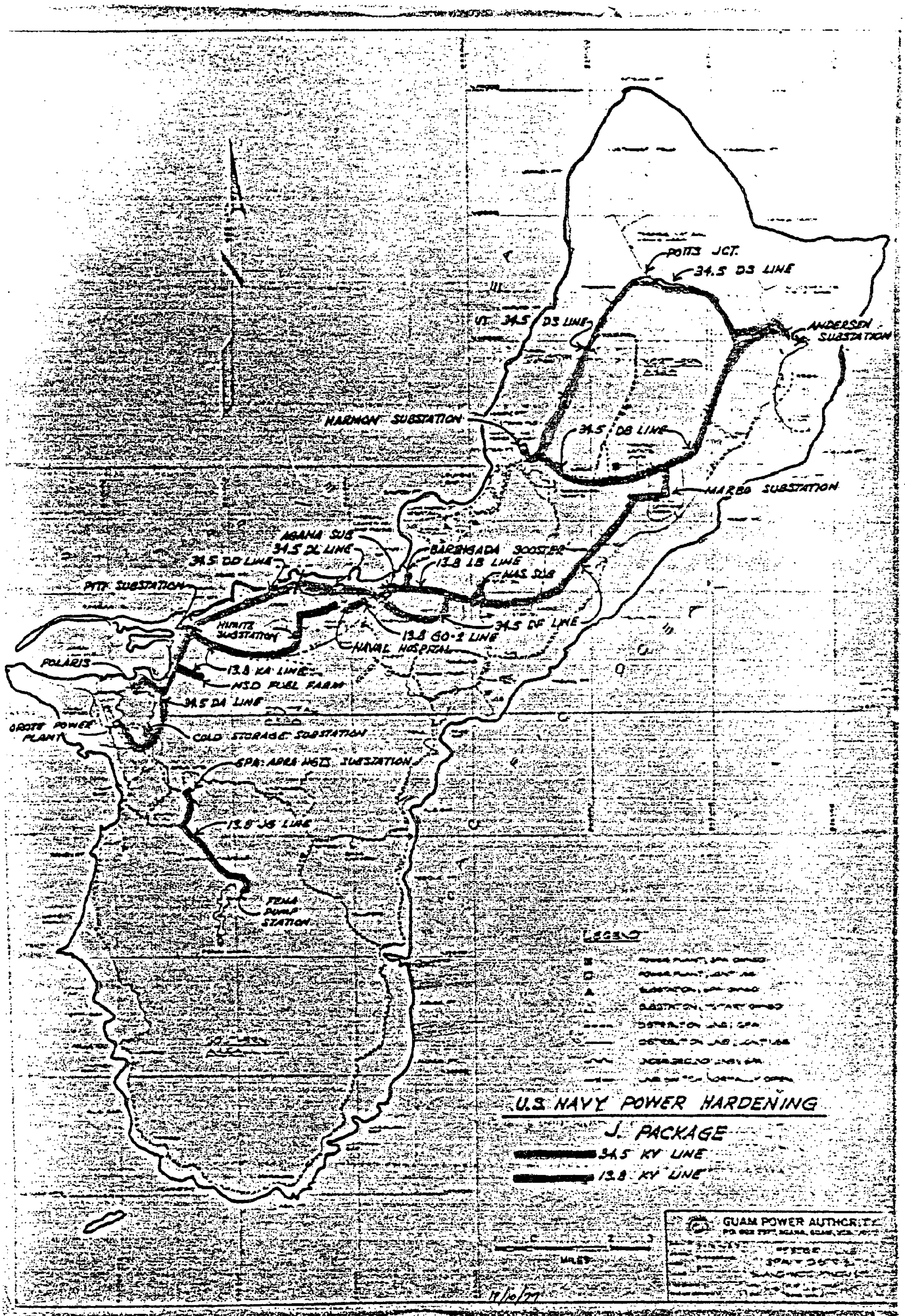
| | MONTH | MTHLY AVERAGE | QTRLY AVERAGE | 6 MOS AVERAGE | ANNUAL AVERAGE |
|---|---|---|---|---|---|
| 1976 | | | | | |
| | Jan | 146,000 | | | |
| | Feb | 143,000 | 144,700 | | |
| | Mar | 145,000 | | 141,200 | |
| | Apr | 146,000 | | | |
| | May | 148,000 | 137,700 | | |
| | Jun | 119,000 | | | 142,200 |
| | Jul | 128,800 | | | |
| | Aug | 140,200 | 138,900 | | |
| | Sep | 147,500 | | 143,300 | |
| | Oct | 147,000 | | | |
| | Nov | 149,000 | 147,700 | | |
| | Dec | 147,000 | | | |
| 1977 | | | | | |
| | Jan | 146,000 | | | |
| | Feb | 142,000 | 144,000 | | |
| | Mar | 144,000 | | 143,800 | |
| | Apr | 143,200 | | | |
| | May | 144,000 | 143,600 | | |
| | Jun | 143,700 | | | 147,900 |
| | Jul | 141,000 | | | |
| | Aug | 155,000 | 150,000 | | |
| | Sep | 155,000 | | 152,000 | |
| | Oct | 156,000 | | | |
| | Nov | 154,000 | 154,000 | | |
| | Dec | 151,000 | | | |

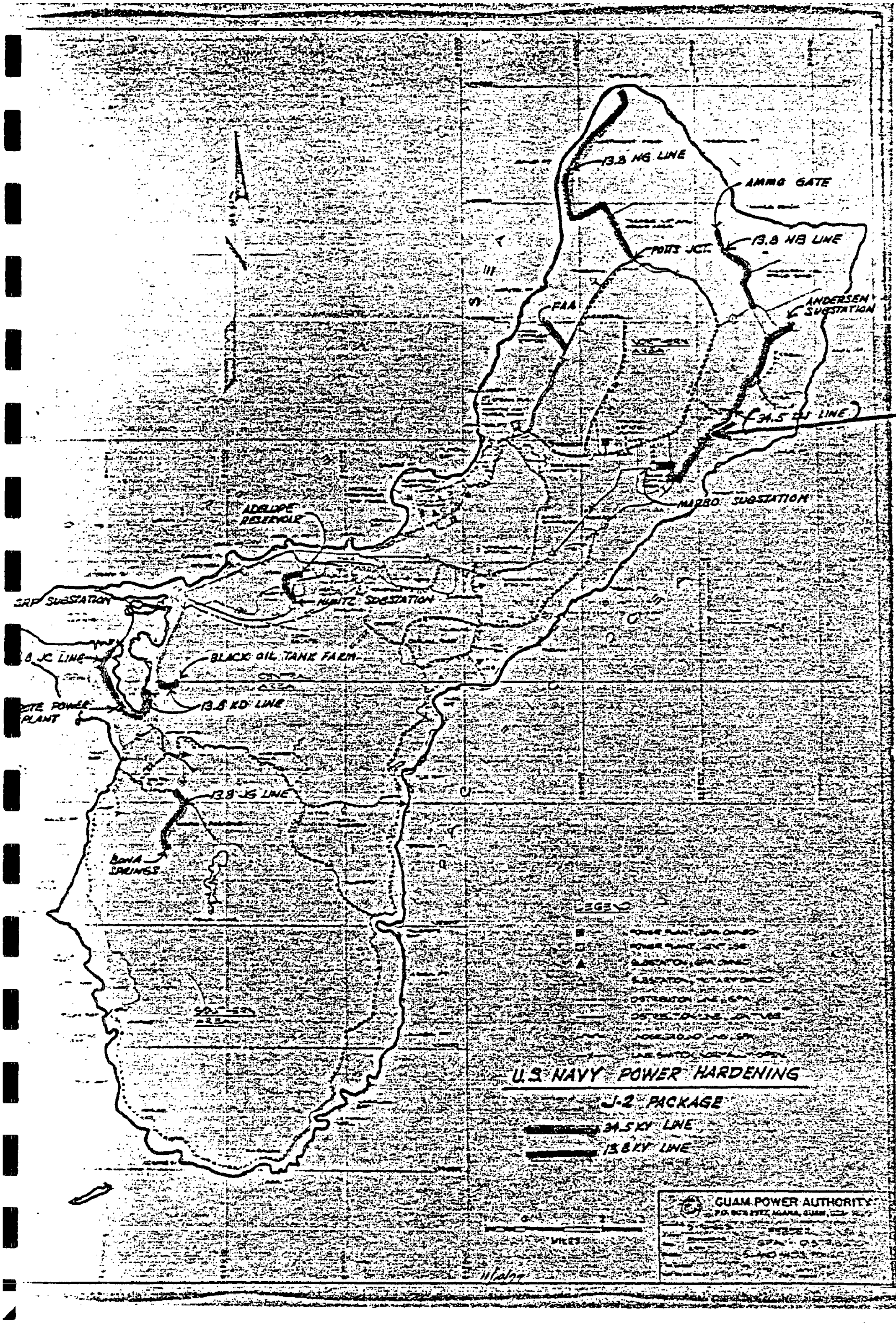
| | MONTH | MTHLY AVERAGE | QTRLY AVERAGE | 6 MOS AVERAGE | ANNUAL AVERAGE |
|---|---|---|---|---|---|
| 1978 | | | | | |
| | Jan | 144,900 | | | |
| | Feb | 141,800 | 144,900 | | |
| | Mar | 148,100 | | | |
| | Apr | 151,500 | | 149,550 | 149,550 |
| | May | 156,000 | | | |
| | Jun | 155,000 | 154,200 | | |
| | Jul | 147,700 | | | |

Source: Guam Power Authority

Appendix 3.

APPENDIX 3: Maps, Power Hardening



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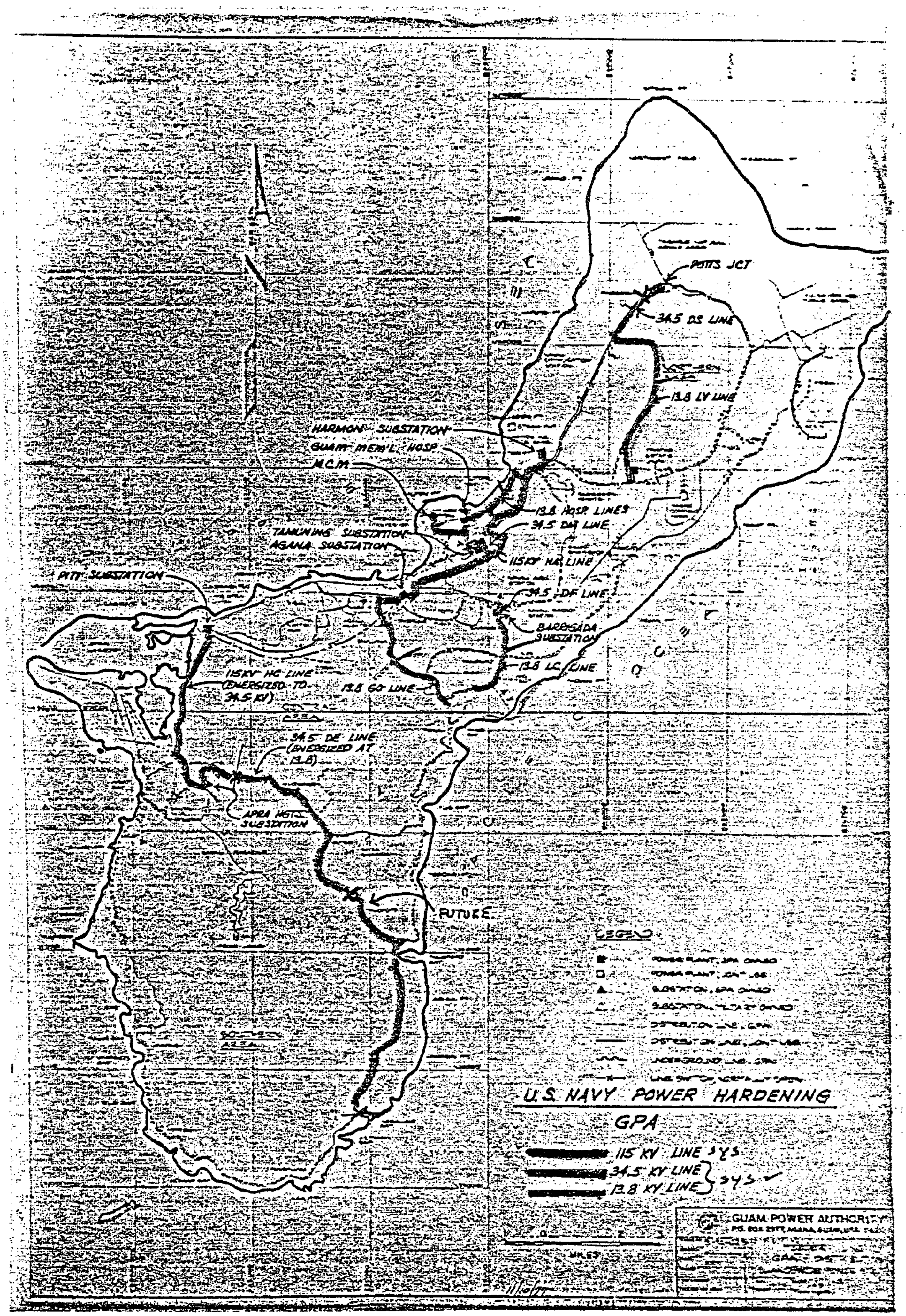
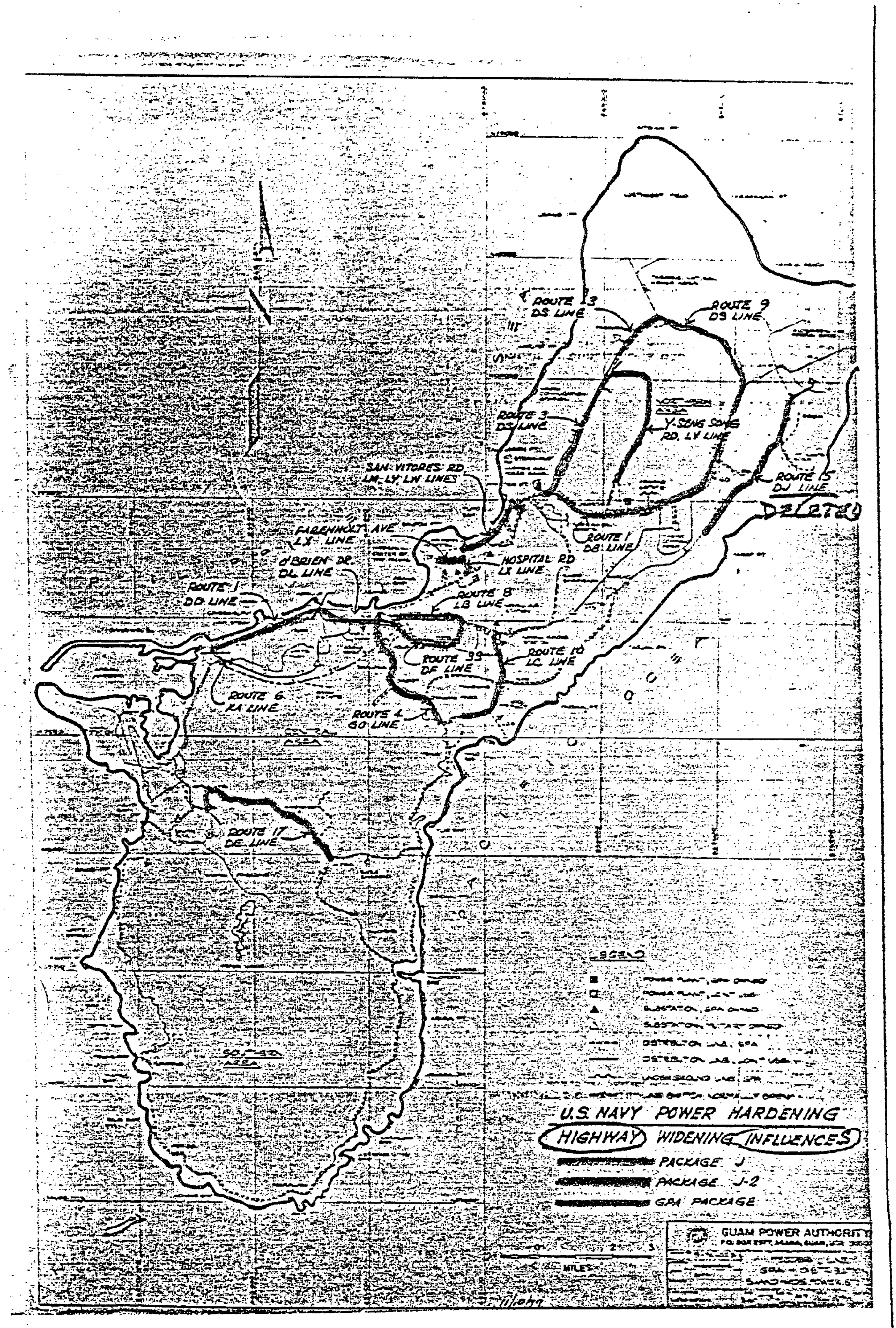
2/14/78



POTTS JCT
34.5 DS LINE
13.8 LY LINE
HARMON SUBSTATION
GUAM MEM'L HOSP.
M.C.M.
13.8 HOSP. LINES
34.5 DH LINE
TAMUNING SUBSTATION
AGANA SUBSTATION
115KV HA LINE
PITI SUBSTATION
34.5 DF LINE
BARRIGADA SUBSTATION
13.8 LC LINE
115KV HC LINE (ENERGIZED TO 34.5 KV)
13.8 GS LINE
34.5 DE LINE (ENERGIZED AT 13.8)
APRA HGTS. SUBSTATION
FUTURE
LEGEND
U.S. NAVY POWER HARDENING
GPA
115 KV LINE SYS.
34.5 KV LINE
13.8 KV LINE
GUAM POWER AUTHORITY


ROUTE 3
DS LINE
ROUTE 9
DS LINE
ROUTE 3
DS LINE
Y-SENG SONG
RD, LY LINE
SAN VITORES RD
LM, LY, LW LINES
ROUTE 15
DJ LINE
DELETED
FARENHOLT AVE
LX LINE
O'BRIEN DR.
DL LINE
HOSPITAL RD
LX LINE
ROUTE 1
DB LINE
ROUTE 1
DD LINE
ROUTE 8
LB LINE
ROUTE 33
DF LINE
ROUTE 10
LC LINE
ROUTE 6
KA LINE
ROUTE 4
GO LINE
ROUTE 17
DE LINE
U.S. NAVY POWER HARDENING
HIGHWAY WIDENING INFLUENCES
PACKAGE J
PACKAGE J-2
GPA PACKAGE
GUAM POWER AUTHORITY
MILES

Appendix 4

Appendix 4

## Federal Participants in the Corps of Engineer's Permit Review Process

### MEMBERS OF CONGRESS

Honorable Spark M. Matsunaga, United States Senate, Washington, D.C. 20510
United States Senator, P. O. Box 50124, Honolulu, HI 96850

Honorable Daniel K. Inouye, United States Senate, Washington, D.C. 20510
United States Senator, 300 Ala Moana Blvd., Rm 6104 Honolulu, HI 96813

Honorable Cec Heftel, House of Representatives, 322 Cannon House Office Bldg, Washington, D.C. 20515
Representative in Congress, 300 Ala Moana Blvd, Rm 4104, Honolulu, HI 96850

Honorable Daniel K. Akaka, House of Representatives, 415 Cannon House Office Bldg, Washington, D.C. 20515
Representative in Congress, 300 Ala Moana Blvd, Rm 5104, Honolulu, HI 96850

### FEDERAL GOVERNMENT

~~HQDA (DAEN-CWO-N) WASH DC 20314~~ (Gen [illegible])
HQDA (DAEN-CWZ-G) WASH DC 20314
Board of Engineers for Rivers and Harbors, Kingman Bldg, Fort Belvoir, Virginia 22060
Director, Defense Mapping Agency, Hydrographic Center, ATTN: NS12, Washington, D. C. 20390
Defense Mapping Agency Depot, Hawaii, Hickam AFB, HI 96853
Director, HQ USAF (PREV), Washington, D. C. 20330
Commandant, Fourteenth Naval District, Box 110 (Code 002), Pearl Harbor, HI 96860
Commander, Fourteenth Coast Guard District, 300 Ala Moana Blvd, 9th Floor, Honolulu, HI 96850
Commander, Fourteenth Coast Guard District, ATTN: Office of Aids to Navigation, 300 Ala Moana Blvd, 9th Floor, Honolulu, HI 96850
Commander in Chief, U. S. Pacific Fleet, Pearl Harbor, HI 96860
Commander, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI 96860
Commander in Chief, Pacific Air Force, Hickam AFB, HI 96853
Regional Director, Pacific-Asia Region, Federal Aviation Administration, ATTN: Planning/Appraisal Staff, APC-4, P. O. Box 4009, Honolulu, HI 96813
Regional Director, National Park Service, US Dept of the Interior, ATTN: Interagency Archeological Services, 450 Golden Gate Ave., Box 36063, San Francisco, CA 94102
Commander, Pacific Division, Water Quality Lab, Naval Facilities Engineering Command, Pearl Harbor, HI 96860
Mr. Jerry Delli Priscoli, Institute for Water Resources, Department of the Army, Corps of Engineers, Kingman Building, Ft. Belvoir, VA 22060
Chief, National Park Service, Office of Archaeology & Historic Preservation, 5113-L Street, N.W., Washington, D.C. 20240

FEDERAL GOVERNMENT (Cont'd)

Director, National Ocean Survey, NOAA (C322), U. S. Department of Commerce, Rockville, Maryland 20852

Director, Pacific Marine Center (CPM 101), National Ocean Survey, NOAA, U. S. Department of Commerce, 1801 Fairview Ave, East, Seattle, Washington 98102

Bureau of Outdoor Recreation, Pacific Southwest Regional Office, U. S. Department of the Interior, 450 Golden Gate Ave, Box 36063, San Francisco, CA 94102

U. S. Geological Survey, Water Resources Division, 300 Ala Moana Blvd., Rm. 6110, P. O. Box 50166, Honolulu, HI 96850

Regional Director, Southwest Region, National Marine Fisheries Service, NOAA, U. S. Department of Commerce, 300 South Ferry St, Terminal Island, CA 90731

Administrator, Western Pacific Programs Office, National Marine Fisheries Service, P. O. Box 3830, Honolulu, HI 96812

Regional Administrator, Region IX, U. S. Environmental Protection Agency, Permits Branch, E-4, 215 Fremont Street, San Francisco, CA 94105

* Regional Director, Region I, Fish and Wildlife Service, U. S. Department of the Interior, P. O. Box 3737, Portland, OR 97208

Area Supervisor, Division of Ecological Services, Fish and Wildlife Service, U. S. Department of the Interior, 300 Ala Moana Blvd., Rm 5302, Honolulu, HI 96813

Secretary's Field Representative, Pacific Southwest Region, U. S. Department of the Interior, 450 Golden Gate Ave, Box 36098, San Francisco, CA 94102

Chairman, Advisory Council on Historic Preservation, National Park Service, Washington, D. C. 20240

Chief, National Park Service, Arizona Archeological Center, U. S. Department of the Interior, P. O. Box 49008, Tucson, Arizona 85717

Director, National Park Service, Hawaii State Office, 300 Ala Moana Blvd., Suite 6305, Box 50165, Honolulu, HI 96850

Federal Information Center, P. O. Box 50091, Honolulu, HI 96850

Director, Coastal Engineering Research Center, Kingman Bldg, Fort Belvoir, VA 22060

Director, Office of Territorial Affairs, U. S. Department of the Interior, Washington, D. C. 20240

Resident Director, Federal Aviation Administration, Route 008, Finegayan, Guam 96912

Commander, U. S. Naval Forces, Marianas, FPO San Francisco 96630

Dept of the Navy, OICC NFECC, M. I., FPO San Francisco 96630

National Aeronautics and Space Administration, Guam Station, Dandan, Guam 96916

U. S. Public Health Service, Agana, Guam 96910

Manager, Bureau of Land Management, Pacific Outer Continental Shelf Office, U. S. Department of the Interior, 300 N. Los Angeles St, Rm 7127, Los Angeles, CA 90012

* Only PNs for Summary of Permit Actions & General Permits

~~FEDERAL~~ GOVERNMENT (CON'T)

National Weather Service, National Oceanic and Atmospheric Administration, Route 8, Agana, Guam 96910
Small Business Administration, P. O. Box 927, Agana, Guam 96910
U. S. Attorney's Office, P. O. Box Z, Agana, Guam 96910
Guam Observatory, P. O. Box 8001, MUO #3, Agana, Guam 96910
Commander, Anderson Air Force Base, APO San Francisco 96334
Commander, U. S. Coast Guard, Marianas Section, FPO San Francisco 96630
Commander, U. S. Coast Guard, Marine Safety Office, FPO San Francisco 96630
Commander, Naval Air Station, FPO San Francisco 96630
Fleet Weather Control, FPO San Francisco 96630
Commander, Naval Magazine, FPO San Francisco 96630
Commander, Naval Station, FPO San Francisco 96630
Commander, U. S. Navy Public Works Center, FPO San Francisco 96630
Commander, Ship Repair Facility, FPO San Francisco 96630
Commander, Naval Supply Depot, FPO San Francisco 96630
Commander, Submarine Squadron Fifteen, FPO San Francisco 96630
Federal Highway Administration, Bridge Division - HNG-31, 400 7th Street, S.W., Washington, D.C. 20590 (PNs for Summ of Permit Actions & Gen Permits

Appendix 5

Appendix 5

CEIP Interviews

| Party | Date | Subject |
|---|---|---|
| 1. Guam Power Authority Guam Energy Office | 8/2/78 | OTEC and CEIP |
| 2. Mgr.-Guam Power Authority | 8/3/78 | GPA OTEC Participation |
| 3. Mgr.-GORCO | 8/4/78 | Preliminary CEIP Discussions |
| 4. DRS. Tsuda, Amesbury, Winter and Eldredge UOG Marine Lab | 8/11/78 | Literature search, Energy Facility Impact Discussions |
| 5. U.S. Coast Guard Seminar Saipan | 8/17, 8/18 | Coast Guard Spill Responsibilities, Contingency Plans |
| 6. Guam EPA Mssrs. Branch, Wong, Pontemeyer, Cabrera | 8/21 | Preliminary CEIP Discussions $SO_2$ and Water Quality Regulations |
| 7. Guam EPA Pontemeyer | 8/24 | Air Quality Regulation Revision Plans, Problems with existing Systems |
| 8. Mgr., Guam Power Authority | 8/25 | Delivery of Preliminary Projections |
| 9. Guam Power Authority, Mssrs. Smith, Benavente, Cabrera | 8/27 | Transmission grid expansion, $SO_2$ and water quality pollution Economics Sales and Peak Demand Data |
| 10. U.S. Navy - OICC Cmdr. Zimmerman | 8/31 | Power System Hardenings, Navy Contract Administration, Navy Transmission Facilities |
| 11. Mobil Oil Corporation Mr. R.S. Rideout | 8/31 | Preliminary CEIP Information Requests |

CEIP Interviews cont'

| Party | Date | Subject |
|---|---|---|
| 12. Esso Eastern, Inc. Mr. Bish Parmar | 8/31 | Preliminary CEIP Information Requests |
| 13. Guam Power Authority MSSRS. Cabrera, Tablante | 9/1 | Detailed Discussions on 115KV Lines, Plans for Expansion |
| 14. Esso Eastern Inc. Mgr., Bish Parmar | 9/5/78 | Detailed facility Expansion and Impacts Discussion |
| 15. GEPA, John Cabreza | 9/5/78 | Bulk Storage Information |
| 16. UOG Marine Lab Dick Randall Dr. J. Marsh | 9/6/78 | Detailed Discussion on UOG/US DOE OTEC Study Participation Detailed discussion on Cabras Plant Impacts on Marine Envr. |
| 17. U.S. Coast Guard Ens. Burndett, MSO | 9/7/78 | Oil Spill Contingency Plans, Port Tanker Traffic Patterns, Traffic Control and Safety Requirements Spill Cleanup, Regional Strike Force |
| 18. Dept. of Public Works Highway Planning, Benavente; Highway Engineering, R. Quijano | 9/11/78 | Highway Construction costs, coordination with power line location, joint use agreements |
| 19. Dept. of Parks and Recreation Mr. Robert Cruz, Dave Lotz, Gary Stillburger | 9/11/78 | Energy Facility Impact on Recreation, Recreation Facilities, Historic sites, Tanguisson/NCS plans, compliance with NPDES requirements |

| Party | Date | Subject |
|---|---|---|
| 20. DPW/PUAG Mr. B. Dela Rosa Mr. Joe Guitierrez | 9/12/78 | DPW Coordination w/Navy hardening projects; waterline costing, placement, sizing and use by Energy Facilities. |
| 21. Department of Public Safety Asst. Chiefs Mesa, Taijeron | 9/13/78 | Preliminary CEIP Discussion, Detailed discussion of equipment needs, oil fire capabilities and budgeting for new equipment. |
| 22. GEPA Mr. R. Pontemeyer | 9/15/78 | Latest of $SO_2$ strategy. |
| 23. GEPA Mr. J. Branch | 9/16/78 | GPA thinking on water quality standards and effluent regulation. |
| 24. Guam Airport Authority Lockheed Fuel Consultant Mr. J. Mazanti | 9/18/78 | Details on plans for expanded fueling facilties at the Terminal. |
| 25. Marine Int'l., Joint Ventures Captain Tarr | 9/21/78 | Port Traffic Operations and increased traffic due to possible energy facility expansion. |
| 26. Mobil Oil Corporation Mgr. - Mr. Barney | 9/22/78 | Detailed facility expansion and impact discussion. |
| 27. GORCO Mgr. Mr. F. Cochran | 10/22/78 | Detailed facility expansion and impact discussion. |
| 28. U.S. Navy PWC Lt. Cmdr. Layman Power Consultant R. Duncan Chief Facilities Engineer | 10/3/78 | Navy Energy Facility Expansion plans; power pool agreement, water arrangements. |

| Party | Date | Subject |
|---|---|---|
| 29. GORCO<br>Production & Sales Mgr.<br>Frank Santos | 10/3/78 | Chemical processing and output data, water availability expansion of tankage. |
| 30. Marine Int'l, Joint ventures<br>Mr. D. Reiss | 10/17/78 | CEIP and Port Operations |
| 31. Dept. of Public Safety<br>Chief Wusstig | 10/17/78 | CEIP and fire safety facilities expansion. |
| 32. U.S. Coast Guard<br>Captain of the Port | 10/18/78 | Traffic control systems & possible CEIP participation. |
| 33. Barret and Associates<br>Scott Kvandal | 10/18/78 | Specific discussions on Agat-Santa Rita water consumptiom & GORCO refinery, plans for new water lines, costings. |
| 34. U.S. Army Corps of Engineers<br>Mr. Frank Dayton | 10/19/78 | COE permit process, CEIP and federal review of permits. |

Appendix 6

WALTER F. PINCKERT & ASSOCIATES
*Engineers and Consultants*
P.O. BOX 2636, AGANA, GUAM 96910

Tel: 477-7550
Telex: 721-6181

Subject: Guam's Coastal Energy Impact Program (CEIP)

Dear Sir:

The Government of Guam, by virtue of having an active program under the U.S. Department of Commerce Coastal Zone Management Program, is eligible for funding under the Coastal Energy Impact Program. Financial assistance is available to GovGuam and its agencies in the form of outright grants, or repayment assistance for such things as public facilities needed as a result of new or expanded coastal energy activity, facility impact planning, or unavoidable losses to coastal environmental and/or recreational facilities.

The initial study to be prepared by Walter Pinckert & Associates is concerned with Planning for the Consequences of Energy Facilities. In order to qualify for future funding from the $1.2 billion allotted over the next 10 years, it is necessary to identify specifically the type of energy facility development which will occur now and in the future.

"Energy activity" is defined to include not only power production facilities, but pipelines, transmission facilities, refining and storage systems, deepwater ports, and associated equipment and/or facilities. To qualify as "new or expanded" such facilities must be those whose siting, construction, expansion, initial operation, or replacement, in whole or part, takes place after July 26, 1976.

The major questions which we will be asking are:

1) What is happening now and what will be happening in the next 10 years (1986) as far as energy facility development is concerned.

2) What specific plans are available now. What level of planning activity is presently being carried out and in the near future.

3) What additional public facilities do you foresee as being necessary as a result of planned expansion or construction of these energy facilities.

4) What are your siting, licensing or leasing policies for additional land areas for new or expanded facilities, if any.

5) Do you foresee any great difficulties posed by environmental regulations insofar as development of additional facilities are concerned .

It is recognized in Guam's new Land-Use Plan, Community Design Plans, Comprehensive Development Plan, Port Master Plan, and the Coastal Management Program that energy facilities will be one of the most critical components of coastal as well as economic development for Guam. With proper planning Guam can share the burden of future expansion with the Federal Government.

The attached sheets provide some additional information relative to this program. We are furnishing the foregoing as advance information on the CEIP program and shall call you by telephone to arrange a mutually convenient date to discuss the implication of the program in relation to your activities now and as planned in the future.

Thanking you for your cooperation.

Sincerely,

W F Pinckert

WALTER F. PINCKERT

Attachments: a/s

ATTACHMENT

## General Information for CEIP, Coastal Energy Impact Program

Note: The following information has been derived from the final regulations of the U. S. Department of Commerce for the Coastal Energy Impact Program. These are found in the Federal Register, Volume 43, No. 37 of Thursday, February 23, 1978.

PROGRAM ASSISTANCE - Four basic kinds of assistance are available through the CEIP.

1. Planning Grants are available to Guam to help prepare for the consequences of all new or expanded energy facilities in the Coastal Zone. Since on Guam the entire island is considered to be a part of the Coastal Zone all energy facilities qualify for examination under a planning grant. Such things as physical impacts and methods of amelioration, summation of natural and recreational resources in the area of proposed expansion, and location and scheduling of required new public facilities would be examples of subjects to be addressed under the present planning grant. A specific example might be the location, design, construction, and equipping of a fire station serving the special needs of energy facility emergencies.

2. Credit Assistance may be available to Guam in the form of direct loans or guarantees of loans or bonds. In the example above, a new fire station may be needed as a result of GORCO, GPA, or oil company facility expansion. Although the community tax base will eventually be expanded, there will be a lag between the time the new fire station is needed and the time the actual revenues from the facility are realized. The CEIP will provide financial backing for Guam as it seeks to acquire funds through borrowing so that public facilities and services can be provided when needed.

3. Repayment Assistance would be available to Guam in the event that it is not able to meet its CEIP credit obligations because revenues from energy facilities fail to materialize as expected. This amounts to a guarantee that a community receiving CEIP assistance will not sustain a net fiscal loss from coastal energy activity. For example, suppose Guam expanded its sewage treatment plant and has put in place new water and sewer lines to accomodate expected additional infrastructure pressures as a result of energy facility expansion; however, conditions change so that expected revenue is not realized. Thus the expected increase in tax revenue which had been counted on to cover the loan or bond obligation which financed the public facility will not be forthcoming. In such a case, the obligation can be covered from CEIP funds. The circumstances under which this could happen are:

1) If Guam had taken a direct loan from the CEIP, or had utilized a CEIP guarantee; and

2) There is a change in scope of the energy activity such that sufficient revenues do not materialize as projected.

Repayment assistance can consist of modification of credit terms, refinancing, a supplemental loan, or a repayment grant.

4. Environmental Grants could be available to help prevent, reduce, or repair damage to or loss of valuable environmental or recreational resources. If, for example, the siting of an energy facility in the past resulted in the loss of or damage to a public beach or boating facility, a community could use CEIP grants to purchase access rights to a similar beach or boat facility area.

COMPLIANCE WITH OTHER FEDERAL REQUIREMENTS - Projects funded with CEIP funds must be carried out in compliance with relevent requirements of other Federal laws, especially the Federal Water Pollution Control Act as amended, the National Environmental Protection Act (NEPA), the Clean Air Act, and the Rivers and Harbors Act.